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Superstills.

TK!Solver

Reviewed

of BASIC

The Mythical Man-Month

10 Languages: Which Is Best?

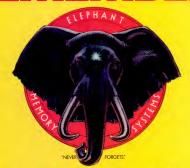
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National Standards Institute (ANSI) says so. The fact

National Standards Institute (ANSI) says so. The tacts oil ElephantTM floppies meet or exceed the specs required to meet or exceed all their standards.

But just who is "subcommittee X3B8" to issue such

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moke life miserable for everyone in the disk-making business.

How By gathering together periodically (aften, one suspects, under the full moon) to concord more and more rules to increase the quality of flexible disks. Their most recent rule book runs over 20 single-spaced pages—listing, and insisting upon—hundreds upon hundreds of standards od sik must meet in order to be blessed by ANSI. (And thereby be taken seriously by people who toke disks seriously.)

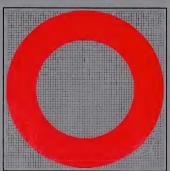
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COVER

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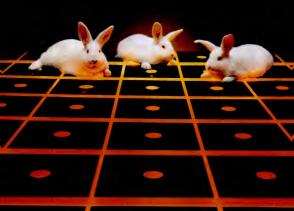
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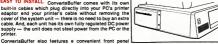


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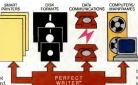
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FROM THE EDITOR'S SCREEN/COREY SANDLER

The tale of a doomed racing handicapper, or, "Why I Never Made My Fortune as a Computer Programmer."

The \$2 Sure Thing

You could always tell a junior programmer when I was in college: He was the one walking around with a cardboard shoe box under his arm.

I remembered the shoe box the other when I needed to transport a bit of coding for a printer selection program from my FC at home to my FC at work. I dumped a copy onto a floppy disk, tossed it into my cost jacket pocket, and dashed out the door to catch the 6:52 from Nanuet (also known as the Toonerville Trolley's poor stepocusity.

Anyway, the phones were already ringing by the time L got to the office and there were meetings to go to and authors to speak to and columns to write and the disk remained untouched in my pocket all day. When I got home that night, the disk was still there, an all-but-invisible passenger through the day.

This never would have happened back in the old days, I told myself, and then I remembered "The Case of the S2 Sure Thing" and its battered shoe box. Actually, I wasn't a shoe box, it was a cardboard box full of IBM punch cards, a weight that could become quite oppressive as the cards began to mount up. You'd never forset you were carrying one.

My friend Ralph and I were two of the very few liberal arts students who dared enter the world of computers back then. It was mostly a matter of curiosity, for everyone knew that writers and business people and other nontechnical people would never use a computer. That's why you hired a computer programmer and a computer operator and a systems analyst and a team of consultants. There was something about computer people that was, well, different from you and me.

So there we were, squeezed in among the engineering and math types in "Intro-





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duction to Programming" in the tample of computing callad "Mechinary Hell." I em not going to attempt to demeen the personal qualities of the rest of the class. (For one thing, they're all probably making much more money than I am todey.) But let ma just say that Ralph and I were the only ones present without a plastic pocket pen protector and in possession of glasses that were not held together at the bridge by a pieca of electrical tape.

Down the hall from us, encased inside e gless-walled, air-conditioned and purified room with double-locked doors, sat the university's pride end joy, a massive IBM 360. Admission to the room wes by speciel pess only, and we viewed with ewe the high priests of the computer who ware parmitted to tiptoe around in its presenca. In 6 years of study, I never touched en ectual computer, only its out-

lying ganglie and peripherals. Computers, I hed been told, lived in a world of precision, where numbers, not words ruled It would be the instructor cleimed, a world in which everyone spoke a linguo franco of IFs. DOs. and GOTOs. Well, I quickly discovered that this simply wasn't true; if anything, computers were already entering into a land of Babel, with arcanely titled langueges like COBOL and APL and LISP. In fect, we weren't even to learn e mainstream languege. Our first experience with progremming was to be one computer model's dialect of a modification of a lenguege: FORTRAN IV with

WATETV.

Punch Card Approach Our epproech to the computer was made at punch card length. We first blocked out our programs using flow charts, than set about writing the coding on special forms marked off into 80 columns. That done, we epproached the dreaded keypunch machines-a combination typewriter and thresher-that stood in rank upon rank in one part of the "user's aree." If you think the IBM PC's keyboard et high speed sounds lika e deranged woodpecker, you should heve haard a skillad kaypuncher at work. There wes e constent fine spray of paper cheff flying out of the business end of the machines, end it clung like lint to the trousers of regular users. The cards flew out of the business end of the mechine end into a hopper, from which you loaded your shoe box. You hed to be careful, of course, to

remove any misspunched cards (or stepled, mutilated, or folded ones) and to wetch out for other people's garbage.

Finelly, the program done, we sidled up to e growling piece of machinery celied a "card reader." Into the device's mew we fed our punched cards. It swallowed them un-sometimes setting a few in the nmcass-and spit tham out down below. And then we left for the day. Sure, computars were fest, but everyone knew there was a waiting line until the old IBM 360 would gat to your program. Come back in e day, or maybe two if things were reelly

busy.

computers were fast, but everyone knew there was a waiting line until the old IBM 360 would get to your program.

And then we came back-back to find thet our elegant 20-line FORTRAN IV with WATFIV program to calculeta college Grade Point Averege (e common "serious" epplication in our class) hed stopped et Lina 2 because we had used a period instead of a comma in e READ stetement. Fix the card, feed the whole peck back into the card reader, and come back in another 24 hours to see if the progrem hed progressed to Line 3.

There was a worse fate than finding a one-page printout with an early error code, end that wes finding e 3-inch thick wad of printout with your name on it in a special reck down et the end of the shelf. The rack was marked "Endless Loops." and anyone venturing to its corner had to face the scornful stare of the clerks whose iob it was to monitor the printer and console, end catch programs sent into limbo by rookie programmers. Guilty, your honor. Regularly.

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cleiming race somewhere and paid \$\$442.87 on e \$\$2 win ticket. Thet seemed like an awful lot of money to us, impoverished college students that we were. Knowing ebsolutely nothing ebout horses and recing, a few of us stumbled across e copy of The Rocing Form in the trash outside an English professor's office.

In case you've never seen. The Rocing Ro-Form, this delily nevespaper is just nevespaper in just nevespaper in just nevespaper in just neves and ratings and timings. For our can find out where a horse has never seen, from what post position it started allwhen it was et the first quarter, at the halfway point, at the top of the stretch, and at a the finish line. You can learn about the finish line. You can learn about the weight carried (lockey plus compensating the purpose of the purpose was not above a horse's purentege. It is a delly updete to a massive deathbase.

Our final assignment for Introduction to Programming was to write e Serious Program. The rest of the class worked on exciting things like The Sieve of Evotamenes, calculating pit to 10,000 places and figuring out the fifteenth Perfect Number. Ralph and I set out to write horse-necing hendicapping program for Vernon Downs.

The program was, in retrospect, a very simple one, elikowshi it hardly seemed so at the time. Every borse hed a card of its morn. We gut on it its total winnings, its own. We gut on it its total winnings, its respective of the control of the cont

The first eight times we tried to run our thick peck of punchcards we got no further than the twelfth card. We tried double-teaming, each debugging a different part of the program, and that pushed us to the fortieth line. And then finally, just 5 devs before our term project was due, the printout we received included a full run of the program, without errors, and with e nice, confident prediction based on that afternoon's racing program: Number 5, on the nose, in the sixth. Well, we could hardly weit until the Sports Final edition of the newspeper mede its wey to the neighborhood candy store. There, in plain bleck type, was red-letter news: The winner of the sixth rece wes Number 5, peying \$17.80 for a \$2 bet. We were cautiously giddy.

We ran back to Machinery Hall and s knocked out another set of punch cards for e the next day's fourth rece and then fed it into the card reeder. Twelve hours later we stood enxiously et the printout bins. A g nice, one-pege printout awaited us: Numthe 5t owin, it advised. And yes, Number

5 won. We were now seriously giddy, the west of yet time to head for our neighborhood bookts. To begin with, it was not yet levedy, and our project was due in the professor's office the next doy. There was one more test—b big stakes race down at Bellmont. We scoured The Rocing Form and put in every variable we could find. We ran the cards through the reader and retrested to our apartments to stew, visions of fists full of which we will be the state of the

Well, we picked up the printout right around post time, and dashed over to the campus redio stetion and stood around the AP sports ticker. We were e little bit skeptical, because once again the computer hed selected Number 5. Well, the probability fector seemed so remote, but somehow as the horses came around the finel turn and into the top of the stretch. Number 5 broke from the back of the field and charged past the grandstand to win an upset victory. We were well past giddy now, but we somehow menaged to pull together e printout of our program and a short, modest summary of our echievements and deliver it to the professor. Saturdey we were going to the treck.

VVE
retreated to our
apartments to stew,
visions of fists full of
winning tickets dancing

At 11 p.m. that night, the phone rang. It was e most solemn Ralph: "I heve e little problem," he began. "I dropped the shoe box and the cards got all jumbled." I leughed. "That's no problem. Just use the

in our brains.



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printout of the program to put them back in order." I seid.

"I did that," Ralph seid ominously. "Do you want to guess what I found?" There was a long pause, and Ralph pushed on unasked: "I found an extra card, just before the print stetement. It wasn't one of ours, it said, 'X = 5'."

computer boldly declared the Number 1 horse a \$2 Sure Thing.

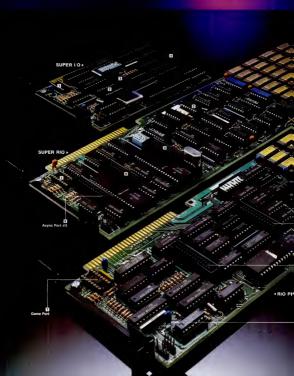
It took just e few moments for the import of Relph's statement to sink in. After all of our computations, and after each horse had been assigned e rating, this infiltreting card was resetting the final X varieble to 5, the seme number we hed seen as our progrem's picks for all three

We mat down et Mechinery Hall at midnight. Relph clutched the shoe box to his breast, the offending extra card waving eccusingly in his left hend. As chance would have it, the computing center was very quiet that night and we somehow managed to hit e sweet spot in time when our program could be reed into the computer and the printout returned to the rack in 20 minutes or so.

We resubmitted the cerds for the stakes race at Belmont. The computer picked the Number 8 horse, e filly that barely meneged to complete the mile-and-an-eighth. We put in the cards for the Sixth at Vernon: Number 3, the program said. Number 3 had belked coming out of the gete and then had struggled gamely to come in eighth. We tried the fourth from Vernon: The computer boldly declared the Number 1 horse e \$2 Sure Thing. According to the newspeper, that borse hed tied for sixth, and than only because two horses in front of him had been disqualified.

We struggled on wearily through most of the night, never egein picking e winner. Things hed been so much simpler when our progrem hed reported felse results. And that is the story of why I never made my fortune es e racing hendicapper . . . or es a computer progremmar.





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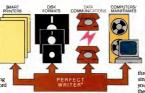
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FROM THE EDITOR'S SCREEN/COREY SANDLER

The tale of a doomed racing handicapper, or, "Why I Never Made My Fortune as a Computer Programmer."

The \$2 Sure Thing

You could alweys tall a junior progremmer when I wes in college: He was tha one welking around with e cardboard shoe box under his arm.

I remambered the shoe box the other day when I needed to transport a bit of coding for a printar selection program from my PC et home to my PC at work. I dumped a copy onto a floppy disk, tossed it into my coat jacket pocket, and dashed out the door to catch the 6:52 from Nanuel (also known as the Toonerville Trolley's poor stapcousin).

Anywey, the phones were already ringing by the time Lgot to the office end there were meetings to go to and authors to speak to and columns to write and the disk remained untouched in my pocket all dev. When I got home that night, the disk was still there, en all-but-invisible pessenger through the day.

This never would have happened back in the old days, I told myself, and then I remambered "The Case of the \$2 Sure Thing" and its battered shoe box. Actuelly, it wasn't a shoe box, it was a cardboard box full of IBM punch cards, e weight that could become quite oppressiva as the cards began to mount up. You'd never forget you ware carrying one.

My friend Ralph and I were two of the very faw libaral arts students who dared enter the world of computars back than. It was mostly a matter of curiosity, for averyona knew that writers and business people and other nontachnical people would never use a computer. That's why you hired a computer programmar and a computer operator and a systems analyst and a

teem of consultants. There was something about computer people that was, wall, different from you and me.

So there we were, squeezed in among

the engineering and math types in "Intro-



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CIRCLE 161 ON READER SERVICE CARD

duction to Programming" in the tampla of computing called "Machinery Hall." I am not going to attempt to demean the personel quelities of the rest of the cless. (For one thing, they're ell probably making much more monay than I em today.) But let me just say that Ralph and I were the only ones present without a plastic pocket pen protector and in possession of glasses that were not hald together et the bridge by a piece of electrical tape.

Down the hall from us, encased inside a glass-walled, eir-conditioned and purified room with double-locked doors, sat the university's pride and joy, a messive IBM 360. Admission to the room was by special pass only, and we viewed with awe the high priests of the computer who ware parmitted to tiptoe eround in its presence. In 6 years of study. I never touched an ectual computer, only its out-

lying ganglia and peripherals. Computers. I had been told, lived in a world of precision, where numbers, not words, ruled. It would be, the instructor cleimed, a world in which everyone spoke e linguo fronco of IFs, DOs, end GOTOs. Wall, I quickly discovered that this simply wasn't true: if anything, computers were already antering into a land of Babel, with arcanaly titlad langueges like COBOL and APL end LISP. In fact, we weren't even to learn a mainstream language. Our first experience with programming was to be one computer model's dielect of a modification of a lenguage: FORTRAN IV with WATFIV.

Punch Card Approach Our epproach to the computer was mede et punch cerd length. We first blocked out our programs using flow cherts, then set ebout writing the coding on special forms marked off into 80 columns. That done, we approached the dreaded keypunch machines-e combination typewriter and thresher-that stood in rank upon renk in one pert of the "user's aree." If you think the IBM PC's keyboard et high speed sounds like e derenged woodpecker, you should have heerd e skilled keypuncher et work. There was a constant fine spray of paper chaff flying out of the business end of the mechines, and it clung like lint to the trousers of regular users. The cards flew out of the business end of the machine end into e hopper, from which you loaded your shoe box. You hed to be careful, of course, to

remove any misspunched cards for stapled, mutileted, or folded ones) end to watch out for other people's garbage.

Finally, the program done, we sidled up to e growling piece of machinery called e "card reader." Into the devica's maw we fad our punched cards. It swallowed them up-sometimes eating a few in the process-and soit them out down below. And than we left for the day. Sure, computers were fast, but everyone knaw there was e weiting line until the old IBM 360 would get to your program. Come back in e day, or maybe two if things were really busy.

computers were fast, but everyone knew there was a waiting line until the old IBM 360 would get to your program.

And then we came back-back to find thet our elegent 20-line FORTRAN IV with WATFIV program to calculete college Grade Point Average (a common "sarious" epplication in our class) had stopped et Line 2 because we hed used a period instead of a comma in a READ stetement. Fix the card, feed the whole peck back into the card reader, and come back in enother 24 hours to see if the program had progressed to Lina 3.

There was a worse fata than finding a one-page printout with en early error code, and thet was finding e 3-inch thick wad of printout with your name on it in e special rack down at the end of the shelf. The rack was marked "Endless Loops." end anyone venturing to its corner had to fece the scornful stare of the clarks whose job it was to monitor the printer end console, and cetch progrems sant into limbo by rookie programmers. Guilty, your bonor. Regularly.

A \$2 Win

Well, it happened in September, some 15 years or so ego, that e horse-his name has blissfully departed from memorycama from out of nowhere in e chesp

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claiming race somewhere and petd \$442.87 on e \$2 win ticket. That seemed like an awful lot of money to us, impoverished college atudents that we were. Knowing ebsolutely nothing ebout horses and recing, e few of us atumbled across a copy of The Rocing Form in the trash outside an English professor's office.

Our finel assignment for Introduction to Programming was to write a Serious Program. The rest of the class worked on exciting things like The Slewe of Eratostenes, calculating pit 01,000 pleace and figuring out the fifteenth Perfect Number. Ralph and I set out to write a horse-racing handicapping program for Vernon Downs.

The program wes, in retrospect, a way simple one, although it hardly seemed so at the time. Every horse hed card of its own. We put to n its total vinnings, its own. We put to n its total vinnings, the state of th

The first eight times we tried to run our thick pack of punchcards we got no further than the twelfth card. We tried double-teaming, each debugging e different part of the program, and that pushed us to the fortieth line. And then finally, just 5 days before our term project was due, the printout we received included e full run of the program, without errors, and with e nice, confident prediction based on that afternoon's racing progrem: Number 5, on the nose, in the sixth. Well, we could hardly weit until the Sports Final edition of the newspeper made its wey to the neighborhood candy store. There, in plain black type, wes red-letter news: The win-

ner of the sixth rece wes Number 5, peying \$17.80 for a \$2 bet. We were cautiously glddy.

We ran bock to Machinery Hall end knocked out another set of punch cards for the next dey's fourth roce end then fed it into the card reader. Twelve hours leter we stood anxiously et the printout bins. A nice, one-poge printout awaited us: Number 5 to win, it edvised. And yes, Number

5 won. We were now seriously giddy.

It was not yet time to head for our neighborhood bookie. To begin with, it was not yet was thrustay already, and our project was due in the professor's office the next day. There was one more test—e big stakes race down at Bellmont. We scound The Bocing Form and put in every variable we could find. We ran the cards through the reader and retreeted to our spartments to stew, visions of first full of winning tickets dancing in our brains.

Well, we nicked up the printout right around post time, and dashed over to the campus redio station and stood around the AP sports ticker. We were a little bit skeptical, because once egain the computer hed selected Number 5. Well, the probability fector seemed so remote, but somehow as the horses came around the finel turn and into the top of the stretch. Number 5 broke from the back of the field end charged past the grandstand to win an upset victory. We were well past giddy now, but we somehow managed to pull together a printout of our program end a short, modest summary of our echievements and deliver it to the professor. Saturdey we were going to the track.

> **VV**_E retreated to our partments to stew

apartments to stew, visions of fists full of winning tickets dancing in our brains.

At 11 p.m. thet night, the phone reng, It was a most solemn Ralph: "I have e little problem," he began. "I dropped the shoe box and the cards got ell jumbled." I laughed. "Thet's no problem, just use the



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printout of the program to put them back in order." I said

"I did that," Ralph said ominously, "Do you want to guess what I found?" There was a long pause, and Ralph pushed on unasked: "I found an extra card, just before the print statement. It wasn't one of ours, It said, 'X = 5'."

computer boldly declared the Number 1 horse a \$2 Sure Thing.

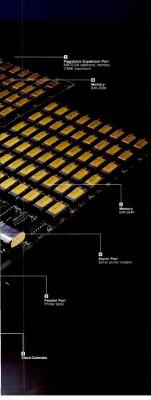
It took just a few moments for the import of Ralph's statement to sink in. After all of our computations, and after each horse had been assigned a rating, this infiltrating card was resetting the final X variable to 5, the same number we had seen as our program's picks for all three

We met down at Machinery Hall at midnight. Ralph clutched the ahoe box to his breast, the offending extra card waving accusingly in his left hand. As chance would have it, the computing center was very quiet that night and we somehow managed to hit a sweet spot in time when our program could be read into the computer and the printout returned to the rack in 20 minutes or so.

We resubmitted the cards for the stakes race at Belmont. The computer picked the Number 8 horse, a filly that barely managed to complete the mile-and-an-eighth. We put in the cards for the Sixth at Varnon: Number 3, the program said. Number 3 had balked coming out of the gate and then had struggled gamely to come in eighth. We tried the fourth from Vernon: The computer boldly declared the Number 1 horse a \$2 Sure Thing, According to the newspaper, that horse had tied for sixth, and then only because two horses in front of him had been disqualified.

We struggled on wearily through most of the night, never again picking a winner. Things had been so much simpler when our program had reported false results. And that is the story of why I never made my fortune as a racing handicapper . . . or as a computer programmer.

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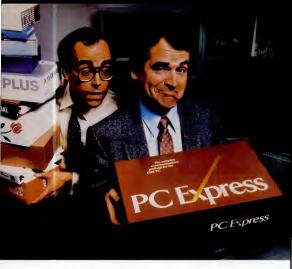
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Letters To PC

Hooray!

Many thanks to PC for calling the ettention of its readers to the use of computers by the hendicapped ("Helping The Handicapped Through Computers" and Dal Vordahl's letter in "PC Tutor," PC, Volume 2 Number 11.

My son Mark, e high-level quedriplegic, bought an IBM PC in December. The quelity of his reports and homework increased greatly. So did his grades. The PC is going to be a real boon when he goes to college this foll.

But, like Vordahl, Mark can only strike one key et a time. We solvent multiple keystroke problem somewhet satisfactorily by buying two teardropsheped fishing weights, cutting off the small wire loop, filing the bottom fletter, and inserting e wire through the hole in the weights.

un weights.

We then pounded the wire into the bottom of the weight and covered the bottom with a nonskid, rubbertied slebric to prevent slipping and marring of the stages. We bent the upper part of the wire space with the stages of the wire the stages. We have the upper part of the wire pick it up with his "mouth stick" for deriven much like on eitheris mout gradient with a stick extending from it.) Mark is now white to pick it up with his "mouth stick" for deriven much like on eitheris mout gradient with the weight on one key, then depress the other with his mouth stick. It's a nuisance.

but it works.

The future use of computers end other electronic equipment in helping the handicapped in communications, employment, and independence is exciting. While I realize that come obstacles to While I realize that come obstacles to ucts may be difficult to owercome, I wish the manufactures would consider submitting some of their products to a panel of handicapped popule for suggestions. Changing a connection here and there may make a product castler for all to use.

It's e metter of thoughtful plenning and

But does anyone heve e solution to those godewfui thick, three-ring menuels? They ere impossible to flip through with a mouthstick without teering the



Thanks again, end pleese keep working to make personal computers berrierfree

Ronald P. McKenzie Green Bey, Wisconsin

Thanks for your letter. For another ideo for handicopped PC-users, see "Multi-Key Solution for Handicopped" in this month's "User-To-User" column.

Mail on Mail Order I wish to commend PC Mosozine! It's

ebout time e publication of your professional status gave recognition to the significant and beneficial role that mail order and discount firms play in the microcomputer software market. I would also like to thank Corey Sandler for his article "Down By The Old Mill Stream" (PC, Volume 2 Number 2). As an IBM PC software mail order firm, we eppreciete his bringing out into the open the truths behind those mail order firms that are honorable.

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Roger Schiller
Technical Support Superviser
Logicsoft
Garden City, New York

I have been involved in the development and marketing of software for more than 10 years without ever making e mail order purchase. I'm skeptical by nature and definitely prefer to see the product before buying.

Recently, after reeding "The Simplicity of QWERTY" by Tom McLaren (PC, Volume 1 Number 12), I decided to experiment. My wife is a budding novelist and needs e good word processor designed for regular people (she's an author, not e programmer). QWERTY sounded sood in the article, but it wes

the \$20 trial that caught my attention. This one seemed too good to be true, and I was willing to spend 20 backs to see where the catch was. I called HFK Software, expecting to be told that I would here to pay the full price and then fight for e refund et e later dete. To my surprise, I was told thet \$25 was all IT would coar to try a full-function OWERTY for a month.

When I asked how long it would take to get a copy of QWERTY to try, I was



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Letters To PC

told that the program would be shipped the next day if I gave e Master Charge number over the phone. Our trial copy must bave been shipped that day, because it arrived almost instantly.

The product is excellent and a joy to use, and as McLerne says in the erticle, "The manual is a model of appropriate documentation." We've been using UWERTY for 2 weeks now end I've found the catch. We were "baited" into trying it for \$52 and now that we're hooked, we'll have to buy it!

Maynard, Massachusetts

Redefinition Redefined

Kenneth Wood's article, "Defining Function Keys With PC-DOS 2.0" (PC, Volume 2 Number 1], was o big disappointment. I want very much to change the meaning of a key and I can't understand the instructions in the DOS manual, but Wood's article was no help, particularly since the example program was written in C.

I find the plus (+) key near the numeric pad to be just about useless. At the same time, when entering deta into a BASIC program, I would like comma I can reach from the numeric keypad. The obvious solution is to change that plus key to a comma. An article that showed how to do that would be really helpful. Michael Trombetts Manhasset, New York.

Kenneth Wood replies:

I sympathize with Michoel Trombetto's difficulties in oftempting to redefine keys while in BASIC. After considerable experimentation, I found that BASIC bypasses the operating system to get its input characters! Therefore, the translotion facility is unworkable for BASIC in-

terpreters.

By the woy, both plus keys are represented in the toble by the some ASCII character: Change one ond you change

the other. Below is a copy of a BASIC program that should have changed the plus to a commo and a C program that octually does it. The program discussed in the orticle was not intended to redefine any key, just the function keys and their shifted, control, and Alt voluse. Examples are in the DOS manual and everything in the program I wrote was based on information presented on page 13-10.

#include "stdio.h" #define ESC "\033[43:44p"

main()

printf(ESC);

"C" program to change "+" to "," 10 S\$ = CHR\$(27)+"[43;44p" 20 PRINT S\$; 30 END

BASIC program that should perform the

Putting the Byte on the PC

More and more menufacturers are producing bardware bet is allegedly IBM PC-compatible, but Zenith Data Systems seems to have put some teeth into the competition. According to an announcement in a University of Michigan research newsletter. Zenith's IBM PC-compatible Z-100 microcomputer has disk drives fitted with uppers and lowers to accommodate "Oubble-dentistry" flopples. The possibility sounds intriguing, and I wonder how it works.

Although this hardware allegedly will operate under PC-DOS, meybe there will be minor varietions in DOS commands: EAT instead of DEL or ERASE? DISK-CHOMP in addition to our old friend DISKCOMP? Will there be e new BASIC commend called BLOAT in eddition to BLOAD?

All this doesn't sound too bad, but it may cause quite a mess when working on WordStor end other programs that sometimes give DISK FULL errors.

Aside from lots of word processing. I use my PC for statistics. It's patched via modem to the University of Michigan's big Amdahl. This works well, but after eill the number crunching I heve to take the results of my stat enalyses and "disperset" them to see what they mean. Maybe the Z-100 will not only process numbers but disset them as well.

Although this new model may take a byte out of the IBM-PC compatible market, I think I'll keep my PC.

Marshel Shlafer Ann Arbor, Michigan

On Gremlins and Graphics

Congratulations for what must be a record for responsiveness to a reader's request. In PC, Volume 1 Number 11, where you published my letter about keyboard troubles ("keyboard Katastrophes"), your four cover stories deelt with diverse aspects of my problem. In the end, my "random" even numbers were cured by plugging the system unit into edifferent circuit.

In spite of all my precautions to evoid electrostatic shocks and to remove most surges and spikes using a Lemon, my PC was unable to handle a 10 volt bias on the nominal ground. Incidentally, i wrote to Boca Raton about this at the same time as I wrote to you and I got a telephone call within a week. Not bad. I second Bob Davis's motion in "Let-

ters To PC" (under the beeding, "Designer Graphics," PC, Volume 1 Number 12) to identify graphics system cheracteristics more specifically. Changing "eyebrows" may belp, but we need to know if devices or programs are compatible with the NAPLPS or GKS standards. For example, one of your advertisers,

Conographic, seems to be inspired by the NAPLPS approach (a sort of super-ASCII for graphics), but never specifically mentions this emerging standard in its litera-



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Letters To PC

ture. The whole question of how to transmit real (not ASCII-character) graphics over phone lines is still up in the air, and most of the products reviewed in Volume 1 Number 12 can't be used with communications programs.

Far East Fair-Hopping R.I. Rahn

en product?

Ste-Foy, Quebec See "Exporting Graphics With NAPLPS," PC, Volume 2 Number 2—Ed.

tails on these conventions?

In "PC-Communiqués," PC, Volume 2 Number 1, you mentioned electronics shows in Japan, Taiwan, and Hong Kong during October 1963. Can I get more de-

'em." and utilize the concepts of a prov-

Cordon M. Greenhlett Phoenix, Arizona

Robert E. Pretti

Saint Louis Park, Minnesota

For further information about these and other Asian electronics shows, contact the following sources: the Jopan Notionol Tourist Organization, (212) 757-5640. ond the Chino External Trade Development Council, (212) 532-7055.-Ed.

Frustrated in Cleveland Great "book": I love it. But please ist

readers know whether a tested program requires a color board. This is very frustrating for those of us who only own the IBM monochrome board.

Russell J. Logan Cleveland, Ohio

We try, for every product we review, (or even mention), to include a summory box specifying requirements. If the softwore requires o color/graphics odopter, or o monochrome odopter, or o lefthanded operator, we'll say so. Unstated means it will run on any ordinarily equipped PC.-Ed.

Founding a Users Group I have been asked to start a computer

club at or near a local community college to benefit college students, individuals, instructors, and local businesses. I have never done this before, but I am experienced and employed in the industry,

and I would like to help. My first guess is that we can set up a group initially as a nonprofit organization and purchase an IBM PC shortly through membership and usage fees. Can you help us? I believe we can start small and grow with the proper guidance and assistance from existing clubs.

Walton T. Brown Los Angeles, California

You're on the right track. See "How To Start A User Group," PC, Volume 1 Number 10. Also check our PC User Group listing which runs in every issue for an existing group in your area, and osk the members for help. Good luck!-

Comparison Shopping

Why do you always compare word processing software with other software? Why not compare it with Wang or Lanier programs so we would know how they really compare to the word processors that have set the standards for the business office?

Larry Grimenstein Cincinnati, Ohio

Our purpose is to serve the needs of IBM PC owners and those with an interest in the field. If you are shopping for o word processor for your PC, the only things that really motter are the relative merits of the available software. However, when we have an instance of a product with a mainframe, minicomputer, or microcomputer equivalent, we do draw the comparison, os we did with MultiMate. o Wong-like word processor .- Ed.

Return To Sender

In "Avoiding The Worst" (PC, Volume 1 Number 11), Winn Rosch states that dust covers for the IBM PC are available from a company in South Gate, California, Microcomputer Accessories, Inc. I have mailed a company check for

the stated cost of the disk cover and companion keyboard cover to the sddress printed in PC. My request for the merchandise was returned stamped "Not

The DOS Dossier

After reading David Rose's review of IBM's new operating system, DOS 2.0 "DOS Marches On." PC. Volume 1 Number 12), I had to ask myself who the drummer in this case should be.

Anyone with experience on the Honeywell Level-6 minicomputer, using the GCOS6 operating system, could not help but notice the similarities between it and DOS 2.0. The concepts employed in DOS 2.0 reflect and sometimes almost duplicate concents used in GCOS6, which has been a highly successful product for Honeywell.

The release of DOS 2.0 should therefore prove highly successful for IBM, especially since it is priced so modestly. With s little practice and planning, a user now has the capability of a more state-of-the-art data management function, which hed been lacking in the past,

When I finished reading Rose's article, several unanswered questions still lurked in my mind: Is DOS 2.0 really IBM's prototype for a more sophisticated operating system, perhaps conceived to replace the outdated operating systems used on IBM mainframe computers? Is it a marketing strategy to undercut

the Honeywell PC base? Little is known regarding Honeywell's PC other than that it is oriented to the business user Has Big Blue finally decided that, in

the end-user demand for user-friendly systems, "if you can't best 'em, join

PC MAGAZINE 58 SEPTEMBER 1983



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Letters To PC

Deliverable as Addressed." I have attempted to call Microcomputer Accessories, Inc. but there is no telaphona listing for it in South Gata. I would still like to obtain the dust

covers. Moreover, I'm curious to know how a magazine of the size and reputation of PC could print the address of a company that is either impossible to contact or nonexistent. Can you supply ma with any more in-

formation concerning Microcomputer Accessories, Inc.?

Iulia Conn Watt Lawrenca, Kansas

It's not our foult: Microcomputer Accessories, Inc. has moved. The company's new oddress is 1545 Pontius Avenue, Los Angeles, CA 90025, (213) 477-4216. The keyboard cover is still \$12, as the orticle stoted, but the disk drive cover has gone up to \$10. There's olso o \$3 shipping and hondling charge.-Ed.

I Can't Believe What I Am Reading! I am shocked and amazed! If there is

anything in the world that computer addicts, from T.V. typewriter amateurs to C-language programmers, agree on, it is the prescription that economical and accurate use of language cannot be compromised

Thus, it is with much consternation that I point out the continued misuse of tha word doto. Data is the plural of datum. Data are!!! Datum is! One can legitimately say, "The database is inadequate," but one emphatically cannot say.

"The data is not considered adequate." This pervasive linguistic hug is all the more surprising given the influx, caused by widespread use of microcomputars, of people who author more than just FORTRAN programs. Worse still is the fact that many scientists utter phrases such as "This data indicates that. . . . " The proper use is, "These data indicate that '

This is not simply a debata between language purists. To use the plural of this noun without the correct form of tha verb to be is simply wrong. I do not expect all comp-heads to know rules of grammar, but aditors can make no axcuses. Our husiness is based on accurate syntax and grammar. It is a shame we don't pay more attention to our English.

Chip Clarke Stony Brook, New York

Data ara. You're right, Sort of, Your letter is a solve in the unending conflict over the mutability of English. We know. of course, that the word data is the plural of datum (just os media, phanomena, and stadia ore plurals of medium, phanomanon, and stadium respectively). However, inosmuch os English locks o central outhority, we toke refuse in the pronouncements of Webster, who, regarding the word data, rather cryptically notes, "pl but sing or pl in const." We would like to preserve data os o plural. The tide is ogoinst us. Data is .- Ed.

Non-Compatible

I committed myself to a 3-year subscription to PC Mogozine because I believed that you were "The Independent Guide to IBM Personal Computers" as you ciaim. You must realize that most of your subscribers own IBM PCs and recognize that machine as the finast personal computer ever built.

I (and I assume we) do not want to hear about compatibles! You promised me a guida to tha IBM PC. Do me a favor and cut out the compatible articles

Thomas W. McGonegal, Sr. Undarhill, Vermont

Very much part of the story of the PC is the sub-industry that has sprung up around it. Some of the "compatibles" so IBM a step or two better, others undersell the product. We define a compatible as a device that will run the same softwore as on IBM, occept the same hardware odd-ons, and (necessarily) offer the purchaser another choice in the marketplace. We think that's all part of our role os "The Independent Guide to IBM Parsonol Computers."-Ed.

Shifting Bands

In Stephen Manes's article, "Toward More Colorful Printing" [PC, Volume 2 Number 1), ha mantions that ha uses an IDS-132 Prism printer with the color option. This is the same printer that I use with my IBM PC, and I also use an allblack ribbon most of the time.

I would appreciate any halp you can give me as to how I can shift through all four bands of the ribbon. My dealer was no halp. Most of my printing is done with SuperCalc. Can the shift be imput through the SuperCalc print option? Is there some setting I can adjust on the printer so that it defaults to a specified band whenever it is used?

Stanley Topper Long Beach, New York

Stephan Manes replies:

Getting a color Prism to shift through the four bands of a block ribbon isn't hard. First moke sure that switch 7 of the lefthand bank of DIP switches is ON (toword the front of the printer). Then turn the printer on, put it online, ond be sure it's not out of poper. Finolly, enter BA-SIC and run the following program: 10 LPRINT CHR\$(27); "Q.5.\$"

Until the printer is turned off or you send it a contravening command, it will then outomotically shift ribbon bands ot the end of each page. For convenience, sove the program os RIBBON.BAS and put it on o disk with BASIC. Then you

con run it from DOS simply hy typing You can also force the printer to use any individual band, fort replace the 5 in the above program with a number from 1 to 4.1 is the equivalent of the vellow band, 2 the magenta, 3 the blue,

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Letters To PC

and 4 (the defoult) the block.

and a (ine dejoint) in circle.

I'm not fomilior enough with Super-Caic to know whether this con be done directly from thot program. If I, like WordSlar, hos room for o "printer initiolization string," you could potch hexodecimal volues into that section. The volues you'd need for ribbon shifting would be 18 51 2C 55 2C 4—equiv-

olent to the program listing obove.

And your dealer should hove known
every word of this. Write o BASIC program that will ploy on endless loap of
Bozo the Clown's theme song and chain
him to a machine that runs it.

A Colorful HALO

In his article "Three Alternative Graphics Boards," (PC, Volume 2 Number 2), Bill Mechrone discussed Orchid Technology's MGA Board and its grephics software, HALO.

As the author of HALO, Media Cybernetics appreciate the favorable review PC gave our product. However, we would like to correct an error regarding HALO's capabilities. Machrone wrota, "HALO provides a number of sophisticated ways to fill or flood shepes and it will probably be able to support full color operations someday, though it is currently eveileble only in monochrome."

HALO was originelly designed for and is currently eveilable on high-resolution color graphics boards. Scion's PC#0 and the Amdek MAI Board both provide HALO as their graphics software. In addition, Lifeboart Associates distributes a version of HALO thet supports the IBM PC standard Color Graphics Adapter.

HALO, which was first shown at the Fall 1982 COMDEX, does indeed support color. In fact, HALO extands the color capebilities of graphics boards it supports. Advanced dithering and hatch fill functions provide 10 shedes of color on the IBM adapter, 125 shades on the Scion PC640, and 125 in Amdek's

320×400 mode (10 in 640 × 400).

William E. Strum President, Media Cybernetics, inc. Takoma Park, Marviand

Bill Machrone replies:

Thank you for clorifying HALD's color copolities. We first exposure to HALD was in conjunction with the Orchid board. Subsequently, I have had a chance to use it with the Scian board os well and have gotten o full oppreciation of its color capobilities. We have not yet tested the version that works with the IBM colorigraphic adapter, but hope to do so in the nor future.

Gonna Be Some Changes Made

A letter by one of your readers addressed the issue of consumer advocey; groups for computer users ("End-Users, United," PC, Volume 2 Number 1). The Better Computer Corporation (BCC) has been founded recently to provide consumer services to PC owners. BCC is a nonprofit organization, created to assist consumers and companies alike.

We at BCC would like to see a change in attitude among those giants who never would heve mede it if we, the consumers, hed not invested in their products and services. Our purpose will be to address the needs of dissatisfied buyers by compiling information based on letters of complaint. We will mail to any party who requasts it a summary of the complaints that have been issued egainst a particular firm. All the conditions and relevent information will be provided in a basic kit evailable to anyone who asks for it. Please send a self-addressed stamped envalopa; we are in the process of receiving epprovel from the Postal Service to mail free literature and information in the future.

We ask ell PC readers to voice their compleints to us. We will do everything possible to help them by making these complaints public through private mailines. by outlishing a "Too 10" chart for the worst service on a monthly basis, and, most important, by informing the firms in question of their performance.

We are starting to build a database of information on companies and products that have hed problems with consumers in the past. One company's file is nearly as big as FC Mogozine itselff we request that all ietters submitted to us be submitted to the company that caused the complaint as well. Our eddress is: Better Computer Cor-

poration, 10301 Holly Hill Plece, Potomac, MD 20854. Farid N. Ghadry

Potomec, Maryland

Educational Software

In response to Margene Todd's lettar "Gebtrave for Students," PC, Volume 2 Number 1), we currently have six educational programs for the IBM PC. EUU-BASIC I and II teach how to program in BASIC EDUNUSIC: and II teach about music, and the KEYBOARD PIANO converts an IBM PC into a piano keyboard. EUU-CIESS teaches chees, For more information give us call alt (707) 763-9700 or write to EuroPro. Inc., 129 Saratosa, Petaluma, CA 19952.

> Micheel Degiva President, EuroPro, Inc. Petalume, California

Over There

In Kahlheen Burton's article "Over There: BM In Japan' (PC, Volume 2 Number 2), she discusses e femous lepinese extr. The correct spelling of hamans is Kyoshi Atunni (not Kioshi). Awar and the she was a superior of Atunum sha was a superior out of the she was a superior of the she was a superior of the she was a superior of Atunum-an an and of the films



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ness presentation. To us, that makes getting the PC640 better than brilliant. That makes it just plain smart. *HALO is a trademark of Media Cybernetics, Inc./**Cheetak is a registered trademark of CENTEC Cort

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Letters To PC

is excellent The photo eccompanying her article is typical of how Atsumi-san often looks in the Walter Mitty-like dream sequancas thet open up eech movia. There are now 31 movies in the series. The protagonist's name is Tora-san (a nicknama meaning tigar; his actual name is Kuruman Toreiiro-san). The films are excellent travalogues of Japan, as Tora-san is an itinerant salesman, usually drifting from one festival to another, selling whetever cheap goods he can pick up wholesale. His sales patter is something

to behold! His homatown is Shibamata in Tokvo, e few hlocks from the Ara river (Arekawa in Jepanese). Our Society's Cinema SIG mada a pilgrimage to Shihemeta during our semi-annual meeting.

held in Tokyo last summer. It seems to us that its only e matter of time before a PC shows up in a Tora-san apisoda.

> Arthur W. Becker IBM PC User Society Pearl City, Hawaii

How to Write to PC

Plaase send all submissions for "Letters To PC." "Usar-To-User." "PC Tutor." or "PC-Communiqués" to PC Mogozine. One Park Avenue, New York, NY 10016. New Product ennouncements should be sent to "New On The Market" at the same eddress. Please indicate the correct department on the outside of the envelope.

All meteriel suhmitted is subject to editing.

Corrections

Jered Teylor, author of "The Bottom Line Strategist" (PC, Voiume 2 Number 3), has

brought the following correction to our attention: According to Teylor, he incorrectly criticized the program for failing to reinvest positiva cash flows or to remunerate capital. Though neither of these operations is

specificelly included in the reports that Ashton-Tete's Bottom Line Strategist (BLS) generates, both are implied by the net present value method that BLS uses to evaluate projects.

In effect, all capital, both debt and equity, is remunerated at the cost-of-capital rate. and positive cash flows are reinvested et the same rate. This is a perfectly proper financiel forecasting technique and Teylor was incorrect to suggest that neither operation was taking place.

The program, Family Reunion, by Personal Software Co. of Salt Lake City, can keep date on hundreds of generations, not just six ("New On The Merket," PC. Voluma 2. Number 2). In "The Empire State Strikes Beck," PC, Volume 2 Number 2, the photo eppearing

on page 509, should have been credited to the New York State Depertment of Commerce.

In "Remote Possibilitias: The Latest Line On The Haavy-Beud Bout" by Stephan Manes (PC, Voluma 2 Number 2), there was an error in Figure 2, item 5, on page 364.

Line 5260 should read: 5260 GOSUB 2500: IF Q\$=CHR\$(27) THEN GOSUB 2655: GOSUB 2655:ABORT=-1 ELSE IF Q\$() "" THEN DT\$(I)=Q\$:IF

DT\$(1)=" " THEN DT\$(1)=""

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the next marring. Iransporter gives me a report of what it did, and at what time it did it.

I like it because it frees up my time during the day. The bass likes it because it saves on our phane bill. (The deaning lodies are still twing to floure it out.)

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W.

A Little Bug Can Do A Lot Of Damage.



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(Note these are the new Show days. The event was once scheduled for Saturday-Monday, October 8-10.)

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Bonjour, PC!

In France-birthplace of the kilo-a byte's called an "octet." Gendarmes recently raided a computer club to stop its illicit copying activities in fasy-les-Moulineaux. And you can buy a personal ordinoteur named Leanord, Logabax, or Yrel, But what about the IBM PC, which has been available in France since the beginning of 1983?

Despite the title of the megazine for its French usersl'Ordinoteur Personnel-it's called a PC, not an OP. The French machine's nemeplate still says "IBM Personal Computer." But, according to the magazine's report. French users get a 6month warranty instead of our peltry 90-day coverage.

They elso get e Gallicized clavier-keyboard to you-that employs the French-standard leyout known as AZERTY (these letters appear where we expect t find OWERTY). The keyboard also puts most accented vowels in the too row; to get numerals you have to use the shift key. Still, keys with such labels as Home, End, and Caps Lock should cause evebrows to arch at the Académie Française-the words are hardly French.

Neither are the shift keys. l'Ordinoteur Personnel's revie compleined that they're "bizarrely located end will disorient those used to traditional



IBM Calls It Quits

We were shocked to read the news that the computing colossus decided to cease production of all products. Why this startline move? The corporation was hored, "My products simply sold too well All we had to do was put my name on it and people signed up. There was no marketing challenge." Our fears over continuing to find a livelihood at PC were allayed when we noticed that this news

em appeared as the lead story in Confuserworld: The Newsweakly for the Confused Community This 36-page parody tabloid is the best of the lot of computer humor items that have appeared recently. To find out more about Kitchen-Net (the local appliance network) or Leon Spinks' secret life in data processing ("No More Head Crashes"), send \$3 per copy to Confusion Inc., P.O. Box 5177, Palo Alto, CA 94303.



keyboards." Apparently IBM's oft-repeated claim that the PC keyboard's unusual arrangement is e "European standard" just iso't the case.

Some other remerks in the magazine will sound familiar to those American users who remember the PC's early days. While IBM itself only offers two programs-Eosywriter and Multiplan-"Every week someone announces a nev rogram 'available for the IBM PC, but it's impossible to see it run, let elone try it out. . . . While we're weiting, the Personal Computer is an empty box." Shades of early-1982!

l'Ordinoteur Personnel interpreted IBM's corporate policy this way: "We don't make the biggest computers in the world: we sometimes get left behind technologically, but we satisfy our customers-eny way we can," The magazine sums up IBM as "Dieu le Pere, en trois lettres." This mot loses a little of its effect in the English equivalent: "God the Fether, in three letters." - Steven Money

PC-Communiqués



Farewell, Manual!

One of the most seed definition and the listory of computer documentation can be found on the third of ten pages of the operating manual for the SOH7 Smart Cable made by IQ. Technologies, Inc., After the fifth and led step of "felow To Set The SCR17's Switch." the manual tells you, "if the date transmitted is garble, do to the "RS2R2 System Dealg Checklit" or pages 3. "If the date transmitted is garble, do to the "RS2R2 System Dealg Checklit" or pages 3. "If the date transmitted is correct, congretulations. You are finished. You may to the rest of this manual."

Now that's the kind of planned obsolescence we like to see.

Furnished For Computing

Clearly not all computers are locked away in dark comes of dens and bedrooms. In a recent survey of members of the American Society of Interior Designers, 15 percent said they spent a significant emount of time adapting homes to accommodate computers and related hardware—only 2 percent had in 1980.

Calling in a team of expensive experts may be a bit ambitious for most people, but there's still room for home improvement. In PC Mogozine you'll find suppliers of elegant dust covers for diskettes, wood-covered cabinets for monitors, stands for printers, and desks for keyboards.

With all this ergonomic furniture. a femily in a house furniture. a femily in a house that's been designed around a PC may be an indestructible unit. Could you or your mate face the prospect of breaking up your happy home if if meant divorcing a beloved printer from its walmut calibrate if you plan to this the road, lack, forget the furniture and greb a Compaq.—Karren Cook.

A Numbers Problem

Do you really want to know how many PCs IBM has sent out into the world? Here's the latest official non-answer from Big Blue itself.

According to a highly placed spokesman in the company, IBM has shipped out more PCs through May 31 of this year than it did in all of 1982.

It did in all of 1982.
This phrasing reminds us of the old math puzzles that want something like: When I was 25, I was twice as old as my uncle. My uncle then was three times es old as my sister. And my mother now is 56. How old will I be in 3 years? Give un? —Corev Sondler.

First Class Mail

The Keeper of "Letters To PC" mentioned that she was disappointed by how few interesting letters have come across her desk. It's easy for her to expect better when she sees Cor and Driver, our neighbor down the hall, receive the makings of the

most lively letters column in any periodical.

So why does PC—one of the world's thickest magazines—get relatively few letters from readers? Is it because most of you have no time left to write after working through 600+ pages every month? Are you waiting until somebody builds a better word processor before you catch up on your correspondence?

Whatever your reason for not writing, it's probably nothing that money wouldn't cure. We want to see some better letters so bodly that we're willing to offer e bribe—your choice of eny word processing softwere edvertised in PC. Just be the one reader who sends us the best letter (in our estimation) that errives in time to be printed in PCs December 1883 issue.

What makes a good letter? If something you read in PC strikes a nerve—for good or ill—just tell us about your own experience and thoughts on that topic. If you feel you need more guidance, look at Cor and Driver.

All letters we receive before the deadline will be eligible for the prize. But, if you think you've written a winner, you might catch our eyes by eddressing your missive to "Better Letters To PC," PC Mogozine, One Park Avenue, New York, NY 10016.

And children. Children! After writing to us, pull out another piece of peper and send a letter to your parents. It won't take more than e moment and it will make them feel so good. They might not be offering a prize, but they're welting to hear from you.



Pay No Attention to the Monitor Behind This Sign



Sure, IBM wanted to talk about its Series'1 Videotex System at a recent show in New York, IBM's flashy exhibit included PCs that were connected to Prestel in England and that displayed NAPLPS images (see "Exporting Graphics With NAPLPS," PC. Volume 2 Number 2). The crowds listened to the earnest demonstrator posed in front of a bugh rear-projection television screen as he explained Big Blue's announced intent to link its PCs and Series/1 minis into the "video and communications revolution of the 1980s." But, the public's eyes kept drifting to the left to a pair of diminutive color screens with pint-sized

keyboarda... Encased in a form-fitting plastic case, smaller than a breadbax, were two 9-inch (diagonal measure) color RGB monitors with untitled IBM nameplates. The Image was sharp and crisp and just perfect for a (HUSH!) portable computer

IBM must have anticipated the ensuing barrage of questions: the monitors were assigned their very own PR man, programmed to deny that the devices had any significance whatsoever. He kept pointing to a printed card on the stand: 'This prototype device

was built by IBM to demons the feasibility of various Videotex/Display functions. IBM makes no representation that these functions will ever be available commercially."

But the questions kept coming, including a few from a crew of Japanese businessmen. Was this a glimpse at part of an upcoming IBM micro-micro? They wanted to know-now

Well, of course, the man from IBM shrugged them off. The two monitors on display are the only ones Big Blue has assembled, he said. The case came from the 4704 Banking Display. And the picture tube, he allowed, was a Panasonic. This admission pleased the Japanese businessmen who, as it

happened, were from Panasonic.



Micro Flea Market

Computer Swan America is a safes of 1-day shows (established 1976) featuring an exhibit of historical personal computers, door prizes, and amazing bargains from over 320 sellers-the prices of their wares sometimes drop wildly as the afternoon wears on.

Come to haggla over used microcomputers (and even minis). peripherals, software, automotive computers, and robots, while the radio-controlled blimp maneuvers over your head inside the Santa

The next Computer Swap America shows are September 10, 1983 and January 28, 1984, from 10 a.m. to 6 p.m. at 344 Tully Road, San Jose, California, For more information call (800) 221--Corey Sandler SWAP, (415) 327-7610, or write to Bux 52, Palo Alto, CA 94302

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PC-Communiqués

Take Me to the Fair

The words "computer fair" bring strange images to a nostalgic mind: A carney berker on the midway calling out "See the sultan's plotter! It shimmies, it shakes, it turns ver eyeballs into knots! Only a quarter!" Or the touching sight of a young software author clutching her blue ribbon and a \$100 bill; but tears run down her cheeks as her program diskette is taken eway to be compiled.

Today's computer fairs have little of the atmosphere of cotton candy, hey bales, moustache wax, and two-headed calves. Still, the following events dealing exclusively with the IBM PC mey be to

the taste of citizens of the Silicon State.

In Toronto, Ontario, the Skyline Hotel and Convention Centre will be the site of PC+2 on September 9 and 10, 1983. This show is sponsored by the Personal Computer Association (PCA) and the Personna Computer Association Inc. (an international association for IBM PC users) Contact Hi Tech Trade Expositions, P.O. Box 99. Aiax, Ontario, Canada L1S 3C3 or phone (416) 686-3866.

Then, from October 4 to 6, 1983, PC'83 will welcome you to Boston's Bayside Exposition Center. The source for more information is Northeast Expositions, 822 Boylston St., Chestnut Hill, MA 02167; call (800) 841-7000 or (617) 739-2000 (in -Jomes Langdell



Spelling Bug

NOW GIVE ME YOUR WALLET ... GOOD ... NOW

le with a moral that's worth repeating: Don't believe everything your computer tells you

Conceptual Instruments Company was the beta tester for another software manufacturer's spelling checking program. In the course of preparing The Desk Organizer (a program reviewed by Paul Somerson on page 247 of PC. Volume 2 Number 2), the text of Conceptual's program was run through the prototype spelling

While testing his copy of The Desk Organizer, our reviewer noticed that the work gouge, which appeared on nearly every screen of the program, was spelled guage throughout. He mentioned this to the manufacturer who recalled that the spelling of this word had been changed from right to wrong et the spelling checking software's recommendation.

This spelling bug was eradicated before either The Desk Organizer or the spelling checker (which prefers to remain anonymous) reached paying customers. However, we should all take this incident es a reminder that we shouldn't abandon our own eyes and memories

Massachusetts).

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Strange Mail

You might think some items you read in "PC Communiqués" are strange, but the things we receive are often stranger. A few weeks ago the mail brought a plastic bottle to this shore. PC's writers and editors were disappointed to find that the bottle was filled with a press release rather than anyone's favorite fluid, [A list of

our preferred beverages is available to publicity persons on request.) The paper and ink inside that

bottle would have been of no assistance in washing down the handfuls of Crackerlacks we extracted from a box that accompained another press release. (PR departments please note: Tastes in our office run more toward Pepperidge Farm

cookies and Godive chocolates t The envelope that had us asking most ouizzically the question "Why us?" was one that held e press packet, including photos, announcing Aqua Tunes-a waterproof belt and earphone that allows you to listen to a Walkman tape player

and radio while underwater.

the attention of a computer

Why was this product brought to

magazine? Perhaps someone thought that PC was short for Pocific Coast? Or will we find that the next model of Aqua Tunes is large enough to enable divers to safely use their IBM PCs in the briny deep? Only the manufacturer can answer these questions: if you really want to ask, write to: Aqua Tunes, 1009 Grant St., Denver, CO 80203, Tell 'em Charlie sent you.



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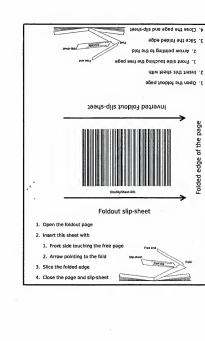
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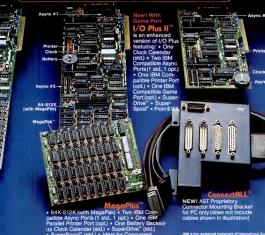
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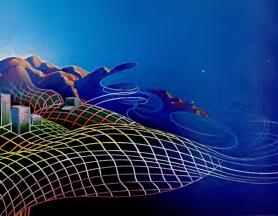
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Introducing . . . The Norton Chronicles

. . . a monthly column by Peter Norton, perhaps the bestknown authority on the internal architecture of the IBM PC and PC-DOS.

Norton was one of the first followers of the PC when it was introduced 2 years ago. Within 6 months, copies of his Norton Utilities began to appear in computer stores. The Utilities have continued, now expanded and updated to deal with DOS 2.0. Users can un-erase files mistakenly killed, and perform other "inside" manipulations.

Norton began his involvement with computers more than a decade ago, starting with systems design, commercial applications and programming on mainframes for companies such as Boeing and the Jet Propulsion Laboratories. Born in Seattle, he now lives in Venice, California. His book, Inside the IBM PC, has just been published by the Robert J. Brady Co. (See "Peter Norton Tells All" in this issue.)

"PCs are the real future of computing and will chart the path for computer companies large and small," Norton said.
"With IBM basing so much of its future on personal

computers, we all know that this is the most exciting and promising area to work in."

We couldn't agree more. Welcome Peter.

Despite the growing list of computer languages available for the PC, only a few are capable of holding up to the ravages of time.

PC Languages: The Living And The Dead This introduces a per column for PC a column will take on a personal element. at any out of increases could be and so

regular monthly forum for topics technical and discussions philosophical obout the rapidly maturing subject of computing related to the IBM Personal Computer.

We all have our individual contributions to make to the community of PC users; the one that I seem to be best eble to make is two-fold: explaining some of the interesting technical aspects of the PC and fawing people's elettenion to philosophical issues in computing—issues that are essy to overlook and that can have important practical implications as new horizons open up with the PC.

Although the well of subjects to write about seems bottomless, I would very much like to invite your participation in this column, through suggestions of those things most worth discussing. Your involvement will be warmly welcomed.

The theme of this issue of PC is program development. One of my several activities is program development for the PC, which means that I have some battlefield experience to share in this area. So, for the first and probably last time, this I tell you what I know about the touchy subject of choosing a programming language for developing programs.

An Embarrassment of Riches The subject of languages is touchy

because most programmers—including me—have opinions that are distinctly individual and often passionately held. That the choice of a programming language can easily be an emotional issue is interesting and revealing in itself, but our topic is program development languages, not psychology (or barroom brawling).

I beve often been asked whet language I use for my own program development, and the fair answer to that question calls for a little history. When I began with the PC it was only a few months old, and there were only two languages available—interpretive BASIC and the Pascal compil-

there were only two langueges available interpretive BASIC and the Pascal compiler. At that time, not even the Mecro assembler was ready. This circumstance didn't present a lot of choice, but it did provide a clear alternative. Interpreted BASIC and compiled Pascal are nearly as different as any pair of languages could be, and so quite a bit of the territory of programming languages was being covered by this limited selection of two. For most programming needs it was quite clear which of the two was better suited to the task of hand; for my work, Pascal was the clear choice.

sen for me (because there wann't any real alternative) and although I had no previous experience with it, I soon came to deeply admire and respect the lean, crisp nature of Pascal and be proud both of the assety features built into the language and of the way it encouraged responsible, attructured programming techniques. Now, with eyear and e half of heavy experience with Pascal, I think of |ft, in general, as the

Although Pascal was more-or-less cho-

choice programming language.

At this point I am usually asked, "So you do all your programming in Pascal?" and I answer, "No, I now do all my programming in C: I don't use Pascal any more." And therein lies the real rub of choosing a language for program develop-

When I began with the PC there were two languages to choose from. Now, there are more than you can keep track of: Naerly every important language is available for the PC and many unimportant ones as well. Often, we have a choice of more than one implementation or version of a language. It is, as they say, an embarrassment of riches. Before, there was too little to choose from, while now, there is so much to choose from that the choice can be impossibly complicated.

To help reduce this complication, here is a combination of my best professionel judgment and my personal opinion about the fectors that should go into an intelligent choice of programming languages.

First, try to avoid being shortsighted. The whole world, including us, is investing billions of dollars in computer program development. We shouldn't squander this investment. Even when we only plan to use our programs for a very limited time and intend to throw our programs awey, we should write them as if they were a precious resource that we would

want to make last as long as possible. The computer you use today won't be the one you are using tomorrow. The wise progremmer uses a programming language (and the features of each languege) that is likely to be available for many years on many computers. This is a strong argument against peculiar languages and homespun languages. In this regard, BA-SIC looks best (in the world of microcomnuters): Pascal and C look very strong as well. Languages like FORTH and APL seem poor choices, while a proprietary languege, available only from the lenguage's creator, is the worst choice of

Another kind of shortsightedness is to choose a lenguaga that you are familiar with, or that you like, instead of searching for the language that is best suited to your needs. Here, I provide a good exampletofollow: I'm switching from a language that I deeply like (Pascal) to one that I'm uncomfortable with (C) simply because it is a better choice for reasons that we will sea

There are some reasons that would lead us to choose BASIC above all other lenguages. BASIC is a good choice for programs that may need to be modified "in the field," aither to allow the user to do some customization, or to make it more practical to distribute corrections. patches, modifications, and improvements. Any interpretive lenguage, such as API and FORTH shares this virtue but BASIC is really the only lenguege that lends itself to change by program users who aren't also program devalopers. Another strong reason for choosing BASIC is to make programs as portable as possible among different brands of computer. In the past BASIC bad the unique advantage of being the only universal lenguage for

is really the only itself to change by developers.

language that lends program users who aren't also program

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ularly C. are stenning into that arene more and more. Both of these reasons-ease of

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change and universality-explain why most programs for business accounting and applications are written in BASIC. Speed can matter a great deal in some programs, elthough I think that the importance of program speed is often exaggarated; meny accounting and game programs do very nicely with the relatively slow speed of interpreted BASIC. When speed matters-or might matter-a compiled language is important. If you are programming in BASIC, you would be very wise to make sure that your programs follow the slightly stricter rules necessary to be compiled; this gives you the option of freely trading between flexible interpreted BA-SIC and fast compiled BASIC. For the best program speed, C and compiled Pascal (but not p-System Pascal) are excellent. while FORTH and even compiled BASIC are mediocre. Sometimes one implemen-

PC MAGAZINE 100 SEPTEMBER 1983

tation of a language is much better then enother: for example, reports here it that IBM/Microsoft's FORTRAN is pathetically slow while Supersoft's FORTRAN is said to be very fast.

well-structured language, but it is also full of tricks, auirks, and quite a bit of cryptic notation.

When the issues of program speed or progrem size are brought up, assembly language usually comes to mind. While essembly language ellows ruthlessly tight programming (programming "down to the bare metal" with no overhead), the plain fact is that assembly languege programming saves programming running time hut squanders the scarcest resource of all, human programmer time. Except for limited special needs, such as the programs thet are most intimate with the computer (like a BIOS control program), assembly language programming is an extravagant waste of human talent and should be avoided whenever possible. Most comniled lengueges are fast enough, but when the best speed or the closest intimacy with the computer is needed, then C stends out among high-level languages. For what is called "systems programming," meaning progrems that must work closely with the computer (rather than from an arm's length relationship, which implies lots of progremming language overhead). C is probably the best language available. Certainly C is widely accepted as such, and that ecceptence ensures that its reputation will be fulfilled. As an example, a close look et the 2.0 version of DOS reveals some C programming language conventions that have been integrated into DOS. Things like this ere best described in terms of "handwriting on the wall" end "e word to the wise," which lead system programmers like myself to migrate to C.

Experienced hands et computing know from painful experience that the cleaner and more comprehensible a program is, the less likely that it will be hugged and the easier it will be to change and improve (as well es to debug). These reesons argue very very strongly in fevor of programming languages that encourage and facilitate what is called "structured programming." The three best known structured languages are PL/I, Pescal, end C. PL/I is not widely available on personal computers, which largely rules it out for us. C is a well-structured language, but it is also full of tricks, quirks, end quite a bit of cryptic notation; from e structured programming point of view, this makes C much less desireble. On the other hand, Pescal bea an unusually clean and clear form, and its heevy use of meeningful English words makes it easier to reed and understand. In eddition. Pascel includes features, such as enumerated deta types and strong typing (which are ideas too complex to explain here), that greatly assist the writing of reliable programs. It is for these reasons that I consider Pascal to be, in general, the best programming lenguage to use. If there is not some overriding reason to use another

languege, I would say Pascal should be the first choice for all of us.

Neglected in this discussion so far are the two lengueges that dominate traditionel large-scale computing, FORTRAN and COBOL. Both of these old lengueges were designed in the dark eges of computing and really should have been thrown out long ago. There is no need for personal computing to repeat the mistakes of traditional computing. The strongest argument for using either COBOL or FORTRAN is to transfer either existing programs or existing programming skills. While this might be legitimately very important to you, I would suggest that you esk yourself if it might elso be shortsighted.

While your judgment and your opinions may not match mine, you should use this sbort discussion as a guide to developing your own rules for making a wise choice among programming languages. Working with a programming language is more like a marriage than like going on a date: you should choose with a long relationship in mind. /PC

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That is a computer inguage? Are language really necessary? Why can't we just talk to computer in English! Why can't whee be one master language for talking to all computers? Computerplobes and crack probless and crack proprammers alluse must deal with the vageries talk obout the widening guil between computer iterates and illimiterates. Computers are, they say, clearly dividing us into the haves and have nots. Are computers themselves

to blame? Of course not; the real culprit is the linguistic contortions necessary to communicate with computers.

Take two simple sentences: "Joe wants an orange. Give him one." The meaning is perfectly clear, even to a 2-year-old. A computer, however, is far too litterninded to make any sense of it. Even if the computer knew what Joe and oranges were, it would have trouble figuring out to whom the "him" was referring. The meaning is further obscured by the Ill-defined

"one." It begs the question, "One what?" As computers become more powerful and we become more skillful in programming them, they will eventually understand us when we speak to them like children. For the present, though, we are limited to formal computer languages.

The concept of a common language for all human interaction with computers is a dream to some, e nightmare to others. Each proponent of a common computer language proposes, of course, that his

native spoken language should be the basis for all programming. One of the goals of researchers currently working on "fifthgeneration" computers is that the machines understand natural language. While some admit to the convenience of natural language, others want to retain the advantages of specific languages. The advantages may range from economy of expression, as in APL, FORTH, end C, to structuring techniques that reduce the chance for error, as in Pascal. It is unlikely that programming languages such as the ones we are covering here will disappear in the next 10 to 15 years, but some of them will fall into disuse. One of the things we'd like to show you is bow the ianguages are comparatively better or worse at specific kinds of tasks. But first, a little background.

Programming History

Programming was originally a process of connecting wires and throwing switches in order to connect the logical elements of the computer together in ways that would solve a particular problem or do some calculations. Early programs were a curious blend of plumber, electrican, logician, and psychologist as they channeled signals around that would sort cards into the right bins or multiply two cards in the right bins or multiply throwing awitches and connecting wires together.

Ones and zeros made the programmer's lot simpler because he only had to code representations of the wires and switches. This was machine language coding. The next step was to use a number base other than binary to represent the settings. Decimal was too unwieldy, and octal (base 8) came into popular use. it was reasonably good at representing the word lengths of some of the early machines (would you believe 13 bits?). Then IBM invented the byte and settled on hexadecimal (base 16) es the best representation scheme. Octal still persists in much of the minicomputer world, despite the prevalence of bexadecimal in the mainframe and microcomputer industries. The next big step in language design

was to have the machine actually read

abbrevietions for the operations that the hexadecimal codes were performing. This meant that every time you punched MUL or some such thing on a card, the assembler would generate the proper bexadecimal code for a multiply instruction. These were the first readable programs, and people could start thinking about structure. Next came the macro assembler, one

■ Basic



BLESS THE first person who realized that electronic patterns of ones and zeros could be substituted for actually throwing

actually throwing switches and connecting wires together.

that would permit a whole series of instructions to be seembled when a programmer-defined word or phrase was read. Variable amone crept in to represent storage locations in memory and the contraction of registers. Askirally, most of these started to get the idea that parhaps you could converse with the machine in a silfed English instead of loading registers and executing operation codes. Following the introduction of macro assemblers. It betures that the contract of the contraction of

Then someone decided that a program could analyze the standard words and variable names used by the programmer, read the standard libraries, and generate the necessary machine code. Thus, the compiler was born. Somewhere along the way, some bright fellows cooked up the notion of an operating system, a set of programs and services that programmers could use in a standard wey. Operating systems permitted multi-tasking, allowing the computer to divide its resources among several jobs. Given the minuscule memory capacity of these early machines. it was important that programs avoid needless duplication of commonly used routines, such as input/output and disk access. This made the designing of compilers easier and greatly simplified

The only language that the central parcenting unit (CUP) really understand is machine code. This is a pattern of ones and zeron (high end low voltage) that causes the CPU to perform certain prodemals instruct the CPU to '10-64' as apocific place inside the machine to see if a key was presend. Another tells it to move a copy of the character typen this or register, a special kind of emergy inside the CPU. A third moves the character from the CPU's register to a specific location in

the lives of programmers.

memory.

Instructions of this sort are used continually by word processing programs and many others. "Talking" to the machine on this level is exceedingly difficult since the properties of the properties of the properties of the properties for you. And cation he wants the machine to perform. Assemblies make this particular job easier by figuring out the proper patterns for you. Short phrases, called memonics, tell the assembler what you want the CPU to do. For example, you might use phrases like:

MOV AX, (char) MOV (loc), AX

As you can see, this isn't much of an improvement over ones and zeros.

Languages are customarily divided into high and low levels. Low-level languages tend to resemble assembly lan-





Focus on Functions

Functions find the words that computer languages can't find for themselves.

Functions are an integral part of modern computer languages. They help you extend the language in a powerful, useful, and controlled manner. The main purpose of a function is to describe something that the language cannot do in terms of things that it can do. Some languages are composed entirely of functions, most notably FORTH and APL. In APL, programs are called functions. In FORTH, they're called words. In either case, they become part of the working environment, available for use in defining new functions or words.

Contrast this to BASIC's function capability, which is actually a macro or shorthand phrase that allows you to tie together a number of standard BASIC syntax statements so that they are executed whenever you use the name of the function. You can pass values to the function by having dummy variables within the function definition. This is the only way that standard BASICs use local variables and a named rather than a numbered subroutine. While that's pretty good, there are still shortcomings. in other than sophisticated BASIC compiler implementations, you have to re-enter the functions into every program

you write: there is no wey to incorporate them into the language.

Programs written in C are an egglomeration of functions as defined by the programmer and calls to standard functions. All of C's input/output, formetting, and string handling capabilities are defined in a standard function library. As such, they are part of the language, but you can add as many other functions as you like. Additions to the function library do not change the syntax of a C program, which enhances portability. C functions may be defined in terms of things that C already knows how to do or in assembly language calls to the operating system, or e mix of the two

PL/I's functions are a bit different, allowing you to define named subroutines within the program or externally. The variables passed to the functions are local and have meaning only within the function. As with Pascal, PL/I ellows you to define your own procedures and functions; indeed, the body of your program resides inside a master procedure celled main. Lisp and LOGO provide for flexible function definition as well

gueges, or provide similar mechine control capabilities, while high-level languages either resemble English or do many complex things in a few economical phrases. Some langueges cloud the issue. Assemblers can have features normally associated with high-level lengueges end high-level languages can get "down and dirty" end interact with the CPU the way an assembler does.

Definitions and Categories Time for some definitions and some categorization. An assembler converts mnemonics, which represent operations that you want the CPU to perform into the mechine instructions (ones and zeros), which ectually do the work. An interpreter takes a program that you have written and scans it, line by line, converting your instructions into machine lenguage as it goes. A compiler scans the progrem you have written and converts it into mechine instructions for execution at some later time. There are some languages or implementetions of langueges that cloud the difference between interpreters and compilers. Terms such as pseudo-compiler and incremental compiler ebound. You will hear some languages referred to as strongly typed or structured. Structured langueges permit you to create procedures



that have one specific entry point and one specific exit or return point. Variables used within a procedure are usuelly "local," meening that they do not affect other values within the program, even if they have the same name. There is always some override provision for making variebles global, or accessible from any part of the program, Contrast this to BASIC, which allows you to GOSUB to a specific subroutine and jump out of that subroutine any time you want, and go literally anywhere else in the program. Such shenanigans are not condoned by structured languages.

Dato typing simply means that you have to tall the compiler the names of variables and what kind of data they will contain before you actually use the variable. Soma languages allow you to predafine the startup value of a variable, while some also permit format statements, which describe how a variable will look when displeyed or printed. Some languages are very loose in data typing, such as BASIC, which ellows you to creeta variables on the fly, with no advance notice other than dimensioning arrays. Others, such as C, require that you specify the variables you are soing to use, but allow considerable flexibility in moving data around from one type to another or mixing data types in calculetions. Pascal and COBOL, on the other hand, are extremely rigid In the wey thay allow data types to be used, and are ganerally considered a good discipline for newcomers to programming.

Strong dota typing meens that if, for example, you dafine one value as an Integer and another as a floating-point number, you can't even add them together. Pascal is strong on data typing to the point of obnoxiousness, while BASIC, at the other and of the spectrum, just makes some assumptions and does what you tell It to do. Other languages fell inbetween, with conversion rules and functions that permit mixing of date types. In the long run, it's probably okay for a language to disallow the mixing of data types, as long as it has convenient operators or functions for conversion of one type to another.

Structure has a different meaning when applied to data. Data structures are a logical outgrowth of data typing. You lump groups of dete types together and give them e name, then you can manipulate all of them as a group (which may be called a "structure" or a "record"). Businass data processing becomes infinitaly easier, programs take less time to write.

was the first high-level language to be implemented on a microcomputer and has been far and away the most prevalent language on micros ever since.

and the functionality and comprehensibility of a program increases dramatically.

■ BASIC

BASIC is an ecronym for Beginners' All-purpose Symbolic Instruction Code. The most common of all computer langueges, it was developed in the early 1960s at Dartmouth College in New Hampshire by John Kamany and Thomas Kurtz. Thair objective was to make the

computer more accessible while retaining the mathemetical and computational power of FORTRAN. The main thing that distinguished BASfC from other languages evailable at tha time was that it was (and still is) an Interpreter. This means each program line you write is converted to machine instructions as the program is executing. Contrast this to compilers. which convert your program to machine instructions all et once, and then allow you to execute the machine instructions. BASIC loses quita e bit in speed of execution, but this is usually offset by the conveniance of being eble to change a line or two and rarun the progrem immediately. without recompilation. You can also run small parts of a program to check the correctness of a section, or you can even run a single line of coda. Professional programmers disdain these features, but then, it was not to them that BASIC was originally eddressed

BASIC was the first high-level language to be implemented on a microcomputer and has been far and away the most prevalent language used on micros ever since. A variety of vendors have created BASIC compilers. These programs allow you to prepare a program with an interpreter, testing it line by line, if you dasirs. When it works the way you want, you feed the source program to the compilar, which converts it to machine code. Thasa com-

> four to twenty times faster then their interpreted counterparts. A faw psaudo-compiler versions of BASIC are around, but thay are falling into



disuse as they are replaced by trus compilars. These pseudo-compilars simply convert BASIC's key words and variable names into coded abbreviations, called tokens. The tokenized program, called intermediote code, is interpreted by a special program called a run-time module. This is faster than a pure BASIC interpreter, but slower than a compiler. BASIC's greatest strengths are the ease

with which it can be learned, and its spaad in gatting something useful on tha

screen. Beyond the fundamentals, BASIC has many extensions, (alled functions, which handla trigonometry, string manipulation, and other complex tasks. Most versions includa a feature called define function. which permits astute progremmers to creata their own extensions. Its greatest and most criticized weakness is its utter lack of structure. Using the GOTO instruction, programmers can (and often do) leap around from line to line in a fashion that would confuse even the program's outhor. This is known as spaghetti code. Other languages, such as COBOL, are not immuna to spaghetti coding, but BASIC almost invites it. BASIC is also a victim of the profassional programmar's snobbery. Having worked long end hard at learning other languages, he can't believe that something so simple can produce commarcially useful results. The time-honored answer to the professional's question, "What's it written in?" is inavitably, "Uhhh, BASIC, but it's an advanced version."

■ COBOL

CÖBOL shares honors with BASIC as the most widely used language. It too is acronymic in name, CDmmon Business COBECL's chief preformed Language, COBECL's chief preformed Language, COBECL's chief pretoring the company of the c

IBM is lergely responsible for COBOL's

popularity in the business world today. Data processing managers sorely needed a consistent approach to designing, writing, and debugging the tremendous number of progrems needed by businesses to break the paperwork bottleneck (and keep tha big machine thay bought from IBM busy). The folly of writing payroll packages and the like in assembler was clear. While a proficient programmer could crank one out in reasonable time, it was virtually impossible for anyone also to understand the program without langthy study. Thus, maintananca and improvement of progrems became a whole new corporate bottleneck. Legions of pin-striped, whiteshirtad salesmen viewad COBOL as a godsand, with code so readable that any manager could ostensibly pick up a program and discern its meaning. While it's true that COBOL takes nothing for granted, its drawback is obvious. You have to tall it averything within the program, including the make and model of the machine it is going to run on. COBOL is file-oriented, meaning that it has built-in commands that understand records, indexes, and the

> SINCE IT'S the oldest of the currently extant languages, some programmers enjoy poking fun at the old dinosaur.

like. If you are shopping for the ideal languege, you can cartainly do better.

FORTRAN

FORTRAN darives its name from FORmula TRANsletion, its sciantific heritage obvious. Since it's the oldest of the currently extant languages, some programmars anjoy poking fun at the old dinosaur. It's really a cheep shot, though. Although we've learned that FORTRAN is a good axample of how not to design a program-

ming lenguaga, its lagacy is clear: It is BASIC's immediate parent. Many features, such as lina numbers, functions, algebraic expression of arithmetic calculations, loop structures, and intarnal storage of deta found their way into BASIC,

with faw changes. FORTRAN's major dasign objectives were to permit scientists to write elgebraic formulas in a form the machine could understand without mangling them, and to provide accass to lots of storaga for number crunching. Furthermore, it provided "messaging" of large numeric arrays. String handling and data structure were hardly considered at all. Some nonstandard features crept into versions of FOR-TRAN, hampering portability of programs and forcing the language back to the standards committees. In spite of this, many complex and useful programs were writtan in FORTRAN, mainly because it was the only game in town. Several popular meinframe databasa managament systems owe their existance to FORTRAN. Back when it was the only decent compiler around for many machines, a group of computer scientists et Bell Labs cooked up Ratfor, which stands for Rational Fortran. It is a preprocessor that allows you to write neat, structured code, which is then translated into normal FORTRAN statements for the compiler. It overcomes many of the objections and problems of FORTRAN programming, but, because its use is mainly limited to universities, it is unlikaly to cause a resurgance of interest in the languaga. Many FORTRAN programs are still in use today and many "Intro to Deta Processing" courses teach it as en introductory language, an act that computer scientist Edsger Diikstra calls e capital offensa. The disfavor into which FOR-

servad. Pascal

Pascal was written as a teaching language go by Nicklaus Wirth, a Swiss computer scientist. It addresses many of the problems faced by FORTRAN programmers and provides e highly structured way of writing programs. The parent lenguage for all block-structured lenguages is Algol, of favorite in Europe, but little used in tha

TRAN has fallen is not entirely unde-

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U.S., other than in some universities. One of its central ideas is that the more GOTOs there are in a program, the more prone it is to error. Therefore, there is no such thing as a GOTO in Pascal.

Fans of Pascal have elevated it to near religion, while vendors of compilers have extended the language in many ways

VIRTH IS both pleased and somewhat appalled by the widespread use and adaptation of Pascal.

Wirth never specified in order to make it usable in business. The main attraction of Pascal is its clean, block-structured approach. The major Pascal offering, UCSD Pascal, works by replacing each statement with tokens and internal symbols, called p-Code. All UCSD Pascal compilars generate the same p-Code, regardless of the processor. When SofTech, the originator of UCSD Pascal, wants to put Pascal on a new machine, all it does is write a new p-Code interpreter for that machine, with appropriate drivers for input, output, printers, and disks. Thus, Pascal programs can be moved easily to many different machines. Note, though, that it is an interpreter. Like pseudo-compiled BASICs, UCSD Pascal will always be somewhat slower than true compilers because the p-Code must be interpreted. This statement, like every other definitive one, contains a contradiction. Some manufacturers have built "Pascal Engines," computers designed to execute p-Code directly. IBM Pascal, made by Microsoft, is a true compiler and bears a family resemblance to Microsoft's FORTRAN, BASIC, and CO-BOL compilers.

Wirth, meanwhile, is both pleased and somewhat appalled by the widespraad use and adaptation of Pascal. He has designed a new language, Modula-2, which incorporates Pascal's design features with sufficient power to handle business applications without add-ons. Perhaps Pascal will return to its intended purpose: teaching people to think in a structured way. Modula-2, by the way, was dasigned to run on e computer called Lillth, which was designed soliely to execute Modula-2 is not an insurmountable obstacle to compiler writers; a PC version of Modula-2 is currently in the works. Perhaps it should have been called Rational Pascal, or RATPAC.

■ APL

API., authored by Ken Iverson (then of IBM), is tha most idiosyncratic of lenguages. APL stands for "A Programming Language," and this is just wheir it is. Whet makes APL outstandingly different from other languages is its unique charecter set—it uses Greek and some special ovarstrike characters—the brevity and power of its operators, and, that it reads from right to left. Furthermore, it is an interpretar in a world in which everyone knows you need a compiler for speed. It was first designed for lerge meinframe machinas, and still needs large quantities of memory if it is to do its thing properly. Programs are called functions in API. and are stored in memory, which is called the Workspace (WS).

APL achieves in place in the large APL achieves and programming languages by being system to the large programming languages by being system to the large programming and so that in a line or two of code and by making it easy to build and menipules large multifulnensional numeric arrays. The language requires a special character set to work on the PC. This can be eccomplished by plugging in a new ROM on the monochrome adapter board or by using

the graphics capabilities of the color board. Of all the lenguages available for the PC, APL is probably the one that benefits most from using the 8087 coproces-

sor's methematical power.

APL is going in two directions at once

APL is going in two directions at once in terms of user acceptance and availabilities on the control of the con

Portability: Which Languages Get Around—And Why

Are any of the available programming languages truly portable?

Portability is the ability to move a program from one mechina to a completely diffarent make and model end have it run successfully. It has long been a dream of systems devalopers everywhare. What makes a program portable! Is there, in fact, any such thing as portability? Yes and no. FORTRAN was supposed to be portable.

FORTRAN was supposed to be portable. It turned out to be one of the least portable environments for programs. What the programs was the program of the protop of the program of the proference of the proference of the protop of

The other problem was nonstandard Implementations. Systems programmers (precursors of todey's hackers) delighted in "improving" the compiler and added many nonstandard front-end and beckend features. Soma of them ware quite good and geined wide acceptence, while others were just obstacles. Then you bad to know whether you were using FOR-TRAN IV, FORTRAN V or WATFU (Waterloo University's version of FORTRAN V), or whether.

The situation was no better with COBOL. Evaryone tiked the idee of COBOL, but no one could agree on a total definition for the language, let elong details of how things should work. Each computer manufacturer produced its own wersion of COBOL, supposedly better than everyone else's, but necessarily incompatible. Fortunately, the Navy was making a

big Investment in computers and programs and wanted to use COBOL.

The Navy's computer brass knew what was going on in the industry and wanted no part of it. They formed e standards committee under the aegis of the American National Stendards Institute (ANSI) to create a stendard for future varsions of COBOL. Grece Hopper heeded the committee and ANSI COBOL was born. Still, vagaries of mechine word length, I/O conventions, control language, and implementation limit the degree to which COBOL programs can be moved around. Portability (in the mainfame world) tends to be excellent among similar machines from the same manufacturer, but falls to pieces rapidly as you branch out to other manufacturers. In the micro environment. the common denominator tends to be the compiler vendor rather than the hardware. So programs written under RM COBOL tend to run on any machine for which Ryan-Macfarland, a manufacturer of COBOL compilers, has implemented a varsion of its compiler.

One reason that there is so much prejudice egainst BASIC is that there are so many versions. Even from e mejor vendor like Microsoft, the implementation for each machine can vary widely. Other vendors (yes, there are others) introduce still more variants. Transletion from one dis-

APL REMAINS attractive because it is an interpreter and

because it is so elegant.

faster, it is much easier to change an opereter or en essumption in an APL program and get the answers without the lengthy compile and link steps usually required by the compilers.

■ PL/I

PL/I (that's a Roman numeral one) is IBM's answer to the Swiss Army knife.

Intended to be all things to all people, it ended up being one of the biggest, most complex languages ever written. It is wordy like COBOL, crunches numbers like FOR-TRAN, has block structure like Algol, and some syntax that isn't too far removed from BASIC. Some of the folks at IBM wanted to call it FORTRAN VI. The result. however, is impossibly unwieldy: PL/I has at least three ways to do anything. The language's many virtues were obscured by its complexity. IBM pushed very hard to make it the de focto mainframe lenguege. but was unable to unseat COBOL. PL/I received somewhat more acceptance from the scientific community, because meny people were ready for something better than FORTRAN. The good parts of PL/I spawned several imitators, special-purpose adaptations, and subsets, including PLM. the systems programming languages Gay Kidali wrose for tain O Her systems programming languages, such as Hewlett-Peckard's SPL, bear a strong resemblence. PLI was saved from ignominy by a standards committee, which sought to whittle tit down to a manegeable size for minicomputers. The committee excised many of the abstruse and redundent features of the language, and created PLI Subset G (for

PL/I HAS at least three ways to do anything.

lect of BASIC to another, especially if file, cursor control, or string operations are involved, can be nearly impossible.

Pascal, given its heritage as a teaching language unencumbered by all the functions needed for business use, has suffred the worst in its transition to an applications language. No two versions are the same. There is an ISO standard Pascal without any extensions that no one uses for business simply because it has no extensions.

APL is another language plagued by the wagate of machine-dependent implementation. APL functions, as stored in the workspace, are not transportable. Any implementation that calls on hardware facilities (like a floating-point processor) specific to the installation will not transport at the source code or canonical representation level. Since most functions are fairly short, reentering them into a new system is not much of an obstacle.

The C language bas fared better than

virtually any other language in terms of transportability of application programs. The machine-dependent canabilities of C tend to be used only for systems programming. C's single-source history and the

fact that the UNIX operating system is written in C are the two major factors. In order to put UNIX on a new machine, you need to have implemented a fully functional C compiler.

C compilers for non-UNIX systems tend to follow the standard C very closely.

There are a few subsets of the language for 8-bit machines, but most of the 18-bit and many of the 8-bit versions are complete. There is no need to extend C because of its ability to handle functions (see sidebar on Functions).

Other than the usual storage boundary (machine word length) problems, PL/I programs tend to be fairly portable. Granted, there are some variants, most significantly PL/C, Cornell University's version. MinIcomputer and microcomputer versions follow the Subset G version and

have a high degree of portability.

The military has been one of the strongest influences on standards in computer systems and languages. The work done on COBOL is the best example, but the brass realized they needed a more modern, structured language similar to PL/I. Pascal, or C. There have been other standard military languages, such as the Air Force's Jovial. Lack of acceptance, poor training. and shortcomings in the language prevented it from becoming a standard. The decision was made to go for an all-new language, designed from the ground up for weapons control systems. This, of course, is Ada. Ada most closely resembles Pascal, with some significant improvements and extensive enhancements. It is big, like the original PL/I and will, its designers bope, be all that the government wants it to be. It is illegal for anyone to produce a subset or otherwise modified version of Ada and still refer to it as Ada. This is one compiler that will provide (if all goes well) full portability. -B.M.



general purpose). It succeeded, and Digital Research built a Subset G compiler that would run on the 8080. It was only a matter of time before it was translated to 8086 code, giving us a version that could run on the PC.

The C Language

The programming language Chas probably captured the imagination of more people than any other modern language. It is relatively unique in having been created as Bell Labs's in-house system davalopment language, then exported to the world through Bell's UNIX operating system. Just before C was developed, another language, called B (after Bell Labs), had been developed in-house. The B language never saw the light of day, but C's authors, Brian Kernighan and Dennis Ritchia, named their new language C for the simple reason that it followed B. In developing C. Kernighan and Ritchie looked at virtually all the programming languages available at

become the language of choice for systems programming.

the time, took the features that they liked, and created a language that produces tight, fast code. It is part of the overall implementation of the Programmar's Workbench, a collection of software tools designed to make it easy to create and maintain programs by project teams.

C is block structured, and is similar in syntac to PL. It is, however, much syntac to PL. It is, however, much excendential in some of its expressions, some especially logical operators. Some periodic logical criticize C because it can be too cryptic. It is also known as a high-level, lower as a high-level, lower language, because it is fairly easy to do things that would otherwise require a separate assemble-and-link step, couldn't be done at all in some lansuages.

C has become the language of choice

T_{H}

programming language C has probably captured the imagination of more people than any other modern language.

for systems programming—the writing of operating systems, compilers, word processors, and other utility programs. Virtually every machine has a full implementation of C available for it, which means that programs can be transported to new com-

puters with relative assa, that thay will run fast, and that they will be relatively small, compared to most other compilers. Portability is aided by C's single-source beginnings; there are few nonstandard versions around. Most of the "nonstandardness" that you find in C shows up in the names given to functions rather than in alterations to the syntax.

C's most distinguishing feature is that it is made up almost entirely of functions. That is, each predefined statement is stored in a library and only becomes part of your program if you use it. You can define new functions, either in C or in assembly language, and incorporate them into the function library. With all the noise currently being made about reusable code in business and professional circles, one wonders if there've looked at C. The



network of users who share C routines, especially in the UNIX world, is enormous, far larger than the PC bulletin board and software network. C is also designed to use the power of the operating system to the greatest possible extent. All of these factors explain why the machine language modules produced by C are so compact.

dBase II

What's a commercial product like dBose II command language doing in a language comparison article? Holding its own. So many people use dBose II on PCs and other micros that it has attained a kind of de focto acceptance as a language. Its major attraction is that it uses the built-in



HE NETWORK of users who share C routines, especially in the UNIX world, is enormous.

database management system, making file-oriented operations a cinch. Syntactically, it is somewhere between BASIC and Pascal, though leaning more toward the latter. For example, there is no GOTO phrase in the language. It is procedural and block-structured, making it easy to read and follow if you don't get too deeply mired in nested IFs.

dBose ff and its command language are the microcomputer descendants of an inhouse database management system of the Jet Propulsion Lab (JPL). Some of the idiosyncrasies of dBose II reflect its singleauthor (Wayne Ratliff) origin. It inherited a number of limitations from its 8-bit, 64K machine origins. A version that would take full advantage of 16-bit processors would be most welcome. Meanwhile, dBose II commercial epplications, including entire accounting systems, are prolif-

The commend language is an interpreter, which is somewhat unique in that it does not require line numbers. This has a negative impact on overall speed, since there is no GOTO or PERFORM statement. DO doesn't count, since it goes out to disk and gets a new program. The interpreter, therefore, must slow through line after line of code, looking for ENDIFs and ELSEs to determine what to do next. One of the conveniences of the dBase II system is the built-in program editor. The best way to describe it is "line-at-a-time WordStor." It uses the same control keys as WordStor for moving the cursor and inserting/deleting characters, but only one line at a time. It's too slow and unwieldy for major editing jobs, but handy for fixing an errant line of code without leaving dBose II. Another advantage results for dBose II's interpretive operation: interactive debugging. There are provisions for stepping through programs one line at a time and for using the printer as a documentation device.

FORTH

FORTH is another modern language, this one created by the astronomer Cherles Moore to control telescopes. It is utterly unlike any of the other languages in this review, either in structure and programming style. FORTH is made up of a small kernel of words, each word performing a specific function like adding two numbers, or fetching something from a file. New words may be defined by stringing old ones together in whatever way you want. The new words have pointers that direct the computer to the locations of the old words. Since the kernel words are written in assembly language, the new words take up little space (they're just an index to the old words) and the whole thing is very fast. The way new words are built on and linked to old words is called threading, and is the real key to FORTH's compactness and speed. The syntax is drametically different from other languages.

ORTH IS utterly unlike any of the other languages in this review, either in structure and programming style.

since it uses reverse Polish operations, as well as a "stack" to store variables, current results, and other partial results of operations. FORTH is well-suited to development of custom microprocessor-controlled hardware, like Moore's original telescope controllers. It is not particularly disposed to general purpose computing, although there are numerous devotees (acolytes?) who beg to differ. FORTH users are usually quietly satisfied with their discovery of the perfect language, while Pascal's minions are fervently evengelical. even violent in defense of their chosen language.

FORTH includes its own program editor and usually its own operating system. Programs are entered and stored in "screens," usuelly 256-byte chunks of program. A few FORTH implementations use the operating system for input and output (screen, disk, and printers), while others completely replace the operating system with FORTH's own.

Some assembly language programmers say they can do everything FORTH can do by using macros. They're missing the point. You've got to really understand the innards of the machine to write good macro code and the results are not (usually) threaded. With FORTH, you learn to think



like a hypothetical stack machine instead of thinking like the particular microprocessor you happen to be working on. Using assembly language to build applications programs is analogous to excavating a basement with a teaspoon. It'll do the job, but its arduous and few

will want to trace

time to modify or correct the program.

LOGO

LOGO is one of the newest languages to arrive on the scene, an outgrowth of learning research and the wey children interact with computers. One of the most outstanding features is the way it There is a special kind of cursor called e turtle. Imagine a mechanical turtle that can crawl around on a sheet of peper. It has a retractable pen in its belly. This is the essence of LOGO's turtle, except that its domain is the screen and it writes with light instead of ink. Children beve found this Imagery wonderfully attractive and the language makes it easy to move the turtle around. What, you may ask, is the significance of a children's language? Well, if that were all that LOCO were it would still be important, because teaching young people to use computers effectively and to think clearly about solving problems with them is one of the largest challenges we face. LOGO has alreedy demonstrated its prowess in this area.

Furthermore, LOGO is not limited to turtle graphics and education. It is just as

L_{ogo is}

just as capable as any other language for problem solving, business graphics and other applications.

capable as any other language for problem solving, business graphics, and other applications. Digital Research's forthcoming version of the language is a case in point. First, LOGO is an interpretive language, based on Lisp, the darling of the artificial intelligence community. The syntax and operators that resemble Lisp provide powerful string manipulation, as well as all the usual arithmetic functions. The result is a full-capability language with integrated record bandling, screen management, and graphics. The possibilities for analyzing and acting upon English-like commands or responses entered by the user

are far greeter than anything else available at the moment

/PC



Six benchmark programs are presented in eleven languages allowing for broad comparisons among the languages.

Benchmark Programs

bw do you go about comparing languages? Some of our descriptions may have given you an inkling as to the particular strengths and weaknesses of certain languages. in addition to descriptions, benchmark programs can be helpful in evaluating languages. A benchmark is a routine, which in this case is written in each of the different languages, to perform a standard task. Here we present six simple routines in ten different languages. Each shows different dimensions of the language and uncovers some strengths and surprising weaknesses. Broad comparisons can then be made among the languages. One thing that benchmarks do not do especially well is tell you what the "fastest" language is. Labeling a language "fastest" based on a series of benchmarks is akin to the blind men describing the elephant.

Our main reason for presenting these benchmarks is to illustrate ways in which a language's capabilities may mesh with your needs. There is also a certain undefinable way in which a language meshes with your personality. Some people strongly prefer the structure of the COBOL environment, while others feel comparisons the comparison of the comparison of

strained by it. APL users claim that that language changes the way they think about problem-solving in general. The convenience of interpreters is priceless to some, worthless to others. A final consideration is the environment for which you're writing programs. Do you want the code to be transportable? To what kind of machines? Will the program be modified in the future by someone other than yourself? Does It have to be fast? Blazingly fast? Are you going to be the only user? Is there a prevailing standard language in the industry toward which your program is targeted? The ways in which the benchmarks are written in our sampler of languages and the performance of each one may help you decide. For our benchmark tests we have selected versions of the languages that are representative of what's available, in no way have we attempted to test every available version of every language. (See the Product Information sidebar for a more complete list of vendors of these languages.)

Once you have selected a new language, give it every chance to prove itself. If you are already proficient in BASIC, you may be overwhelmed by the seeming complexity of PLI or the abstractions of APL You may, on the other hand, take immediately to the structures of C or Pascal. In most of C or Pascal. In write a program than you are doing in BASIC, the exceptions being APL and PORTH. So, buy a book; buy two books. Take a course. But learn your new language, Give it a chance to show its stuff.

Actual Benchmarks

Our first benchmark is simply an empty-loop. We'n asking the machine to do nothing 10,000 times. This gives us a shandie on the flat-out looping—or terretion speed of the language. Since asking any singuage to do something just once is like asking to see the fastest draw in the West (Wanna see it signif). We must ask it to repeat a task many times in order to find out low long it state for one past through, do the empty loop test, while CJROst do the empty loop test, while CJROst

The second test, Integer addition, adds one to a variable until it equals 32,767, the limit for a 2-byte signed integer. Integer addition, like looping, is important in gauging a language's performance in timecritical operations.

The third benchmark, floating-point arithmetic, takes the mathematics out of the CPU and into memory, since double-precision or floating-point numbers are too large to fit into the 8086's registers. This routine gives you a handle on the relative efficiency of the floating-point calculation routines built into the language, an important consideration if you are doing lots of mixed or repetitive calculations. String concatenation is our fourth test.

In it, we assign strings to two variables, then combine the two variables into a third. Languages vary widely in their ability to handle strings and, while this test is far from inclusive (finding substrings within strings is another important feature), it is indicative of overall string-han-

```
Figure 1: An empty loop, expressed in BASIC.

1 'Empty loop in BASIC
5 DEFINE X
7 TIRES = 10
10 FOR X = 1 TO 10000
```

```
Figure 2: A FOR-NEXT loop.

1 'Integer count in BASIC 3 DEFIRE 4 50 5 71RE 4 50 5 71RE 5 70 5 71RE 5 71RE 5 70 5 71RE 5
```

```
Figure 3: DEF instructions for the BASIC interpreter.

1 'Floating point
7 'TIRE' - '0'
10 FOR X - 1'0'
10 A-01.B-1.234.5sict-78.9
```

```
Figure 4: To slow the program down strings are assigned within the loop.
```

```
1 'String concetenation test,
5 DEFINE X.
10 FOR X - 1 TO 10000
20 A3 - "This is a string"
30 a1 - "This is a longer atting with lots of words in it."
450 KZ A4-08
50 KZT A4-08
60 FAINT TIMES
```

40 A=B/C 50 NEXT

60 PRINT TIMES

30 PRINT TIMES

Figure 5: Toble lookup in BASIC.

```
1 Table lookup test.
3 DEFINT B-Z
5 DIM A(25)
8 TIME$ = "0"
10 FOR X = 1 TO 1000
         RESTORE 200
20
         FOR LOOP = 1 TO 25
                  READ A (LOOP)
         NEXT LOOP
50 NEXT
60 PRINT TIMES
70 END
200 DATA 1,2,3,4,5
210 DATA 6,7,8,9,10
220 DATA 11,12,13,14,15
230 DATA 16,17,18,19,20
```

240 DATA 21,22,23,24,25

Figure 6: This benchmork demonstrates BASIC's ease in hondling records.

```
l 'File accese test.
3 DEFINT X
5 THME$ = "0"

10 OPEN "R",1,"TEST.DAT",132

20 FIELD $1, 132 AS RECORD$

30 FOR X = 1 TO 100
40 PUT #1,X
50 NEXT X
60 'read records back.
70 FOR X = 1 TO 100
80 GET #1.X
90 NEXT X
100 'modify and rewrite records.
110 POR X = 1 TO 100
120 GOSUB 200
130 LSET RECORDS = "Modified"
140 GOSUB 300
150 NEXT X
160 PRINT TIMES
170 END
200 GET #1.X
210 RETURN
300 PUT #1.X
310 RETURN
```

Figure 7: In LOGO, the string concotenation test.

```
TO STRIBG.CONCATERATION
MAKE 'A ITHE IS A STRIBG
MAKE 'B THES IS A STRIBG WITH LOTS OF WORDE IN IT.)

EACH 'CONCERNED IN IT
AND 'CONCERNED IN ITS
REPEAT 1000 ISTRIBG.CONCATEMATION;
EACH 'CONCATEMATION;
EACH 'CONCATEMATI
```

dling speed

The fifth test produces the greatest variation when translated to other languages. This is because languages vary drastically in the way in which they store data in tabular form internally. In the case of BASIC, DATA statements are accepted uncritically by the program. If there were an error, such as an alphabetic character among the numbers or a misplaced comma, it would not be detected until you ran the program. In a strongly typed language like Pascal, however, the compiler would check that each entry matched the declared data type during the compilation process. It is nearly impossible to get bad data into languages that are strongly typed.

The final lest is the only one that goes vioutside" memory to the disk. It gives some indication of the case of handling files and the relative efficiency of the interaction with MS-DOS. We selected a file length of 132 because it might represent the width of lines to be printed in a real application, and because it does not agree with the sector size or any even fraction thereof of the operating system. Overall, we were pleasantly surprised at the

ONE THING that benchmarks do not do especially well is tell you what the "fastest" language is.

speed with which the languages handled disk I/O. Note that PC LOGO does not handle file-oriented functions at this time, so it did not participate in this test.

Not having experience in all the languages that are being tested, we farmed out the actual coding chores on some of the languages from our BASIC prototypes. Each of the persons or companies is an expert in the language we assigned. Their comments are included in the body of this article and in various notes within the tables and sidebars.

BASIC

Here is our empty loop in BASIC (see Figure 1). Note that we do not use the variable name in the NEXT statement to maximize speed.

Counting to 32,767 can be done either of two ways, with a WHILE loop or a FOR-NEXT loop. FOR-NEXT is many times faster (see Figure 2).

Floating-point operations are assumed by the BASIC interpreter unless instructed otherwise by a DEF instruction (see Figure

Notice that we are assigning the strings within the loop (see Figure 4). This slows the program down, but this is all right for a henchmark

An interesting finding in this benchmark is that BASIC converts the representations in the DATA statements (which are stored as you typed them) to single-precision numbers faster than it can convert them to integers (see Figure 5).

BASIC's ease in handling odd-sized records is evident in this henchmark (see Figure 6). It has an advantage over languages that only provide sequential access to files or that require files to be closed or "rewound" before they can be reaccassed

I LOGO

Bill Glass, of Harvard Associates, provided our LOGO routines. Written by Gold Hill Computers, Inc., of Lincoln, Massachusetts, PC LOGO is a product of Harvard Associates. Bill comments: "LOGO is very different from other languages, since it provides an integrated programming environment (combined program editor and runtime support). This frees users from having to control storage allocation, but intermittent garbage collection freuse of memory) can potentially extend computation times."

The technique used for implementing the string concatenation test is similar to that used in the floating point test (see Figure 7).

```
Figure 8: In LOGO, the internal data lookup test.
```

```
TO INTERNAL DATA LOOKUP
MAKE "OATA (1 2 3 4 5 6 7 8 9 10 1I 12 13
14 15 16 17 18 19 20 2I 22 23 24 25)
HAKE "A "
REPEAT 25 MAKE "A SENTENCE (A FIRST (DATA MAKE "DATA BUTFIRST (DATA)
```

TO INTERNAL.DATA.LOOKUP.TEST REPEAT 1000 [INTERNAL.DATA.LOOKUP]

Figure 9: In COBOL, the working storage section for the string concotenation program

IDENTIFICATION DIVISION. PROGRAM-ID. STRING. ENVIRONMENT DIVISION CONFIGURATION SECTION SOURCE-COMPUTER. VICTOR 9000 OBJECT-COMPUTER, IBM-PC.

DATA DIVISION WORKING-STORAGE SECTION. A PIC X(16) VALUE "This is a string".

PIC X(48) VALUE 77 B "Thie is a longer string with lote of words in it". 77 C PIC X (64) PROCEDURE DIVISION

000-MAIN. PERFORM CONCATENATE-STRING 10000 TIMES. CEOD DIIN

CONCATENATE-STRING. STRING A B DELIMITED BY SIZE INTO C.

Figure 10: COBOL's reod/write/modify program.

IDENTIFICATION DIVISION. PROGRAM-ID. FILEHN ENVIRONMENT DIVISION CONFIGURATION SECTION. SOURCE-COMPUTER, VICTOR 9000 OBJECT-COMPUTER, IBM-PC. INPUT-OUTPUT SECTION.

SELECT TEST-DATA-FILE ASSIGN TO DISK ACCESS MODE IS SEQUENTIAL.

DATA DIVISION. FILE SECTION.

TEST-DATA-FILE LABEL RECORDS ARE STANDARD VALUE OF FILE-ID IS "TEST.DAT". TEST-RECORD PIC X(132).

WORKING-STORAGE SECTION. DOLLAR-RECORD PIC X(132) VALUE ALL '\$'. 01 SWITCHES.

PIC X VALUE 'N'. 03 E-O-J-SWITCH 88 E-O-J PROCEDURE DIVISION. OCC-MAIN.

OPEN OUTPUT TEST-DATA-FILE. PERFORM WRITE-NEW-RECORD 100 TIMES. CLOSE TEST-DATA-FILE. OPEN I-O TEST-DATA-FILF. PERFORM REWRITE-OLD-RECORD UNTIL E-O-J. CLOSF TEST-DATA-FILF.

COOD DIIN WRITE-NEW-RECORD. WRITE TEST-RECORD. REWRITE-OLD-RECORD. READ TEST-DATA-FILE

AT END MOVE 'Y' TO E-O-J-SWITCH. IF NOT E-O-J REWRITE TEST-RECORD.

LOGO begins to show its unique talents in the internal data lookup test. The words FIRST end BUTFIRST are used to select the first element from the array end

DON'T USE COBOL if your application is primarily personal or if you know that it will not be used 2 years hence.

then eliminate the first element from the remainder of the array (see Figure 8).

COBOL

Mark Wisan, pessioned of V.P.
Communications, line has been weight
with COROL since 1973 as a programmer
yethers analyst, and consultant. Most of
his experience has been with BIM 360/370
COROL and BIA database application,
V.P. Communications, line, provides sales
and support of business and person
ming in diBues if COROLL, and BASIC for
Victor 9000s, IBM PCa, and PC compatibles.

Wisan reports that IBM PC COBOL (Microsoft COBOL) is very similar to the versions that run on very large IBM systems, as well as on mainframes from other manufacturers. In addition, the Microsoft COBOL source code runs with only minor changes on 8-bit CPPM systems, and most computers that support MS-DOS.

Wisan comments, "Don't use COBOL if your application is primately personal or if you know that it will not be used 2 years hence. Don't use COBOL unless you are willing to write for future programmers who may have to modify your code when you are no longer available to advise them. Don't use COBOL unless you are willing to take the time to carefully design your application and get it going in a modular "top-down" structured fashion."

V.P. Communications, Inc. is located

Assembly Language

In most assembly language programs, well over half the characters are comments, which are helpful in understanding the program's logic.

Writing in assembly is the way to wring the maximum utility out of your mechine. If it can't be done in assembly, it can't be done at all. If code must run as fast as possible, or must be compressed into the smallest possible amount of memory (note that these two are not necessarily competible objectives), assembly language is the language to use

In a good assembly languege program, well over half the characters in each source file are comments rather than code. For trivial programs such as the string concatentation program, the comments are not absolutely necessary, but are included just to give the reader a sense of what is going on.

In other programs—internal data table lookup, record create, read, update—the comments are essential. They serve to remind you of what you are doing as you write, and they make it possible to modify or correct the program without having to completely re-analyze the logic every time.

Anyone who has tried to figure out how a program works by looking at the uncommented code produced by the U (unassemble) command in the PC's Debug utility will immediately appreciate the value of comments. Even the sparse ones are helpful for understanding program logic.

In assembly, there is no pretense that the code in itself is "selfdocumenting." The microprocessor is designed for computing power, speed, and efficiency first; ease of programming is, at best, a secondary design consideration.

Historically, Intel has not been known for producing machines that are easy to program in assembly. The 8088/8086 family is no exception. These microprocessors are filled with little quirks and special situations that allow the programmer to squeeze every possible bit of computational speed out of the technology.

As a consequence, learning to program the 8088 in assembly language requires rote memorization of miscellaneous special features. For example, the 8088/8088 family all bave eight 18-bit general-purpose registers, denoted AX, BX, CX, DX, SI, DI, BP, and SP. They are general purpose in that each register can be used for addition, subtraction, logical operations, end shifts, but each register elso has one or more special purposes:

- AX must contain one of the factors when multiplying.
 - BX bas a special role in translating character codes.
 - CX must be used with looping and repetition instructions.
 DX must be used to bold I/O
 - addresses greater than 255.

 SI points to the source characters in a
 - string move.

 DI points to the destinction in a string
 - move.

 BP as an address pointer points into
 - the stack by defeult.

 SP has stack maintenance as its primery function.

$T_{\!\scriptscriptstyle HE}$

microprocessor is designed for computing power, speed, and efficiency first; ease of programming is, at best, a secondary design consideration.

The ebove list is not complete. There are additional special purposes for each "general-purpose" register, and the programmer must be familiar with ell of them in order to write efficient 8088/8086 code.

Since each register hes been essigned special functions that it alone can perform, velues mey not alweys be in the par-

who does a significant amount of assembly language programming builds up a library of subroutines and pieces of code that can be used as building blocks.

ticular register where they are needed. The contents of any registar need to be shuffled around, which is one of the things that makes the code of the floatingpoint operations program somewhet convoluted. Part of the program has no purpose other then to move e pertiel result out of the wey or into a register with e particular special purpose.

Although it is possible to write assembly language programs from scratch, enyone who does a significant amount of essembly language programming builds up a library of subroutines end pieces of code that can be used as building blocks. The IBM PC Mecro Assembler facilitates the use of such building blocks by providing an "include" instruction and a "macro" processor. The "includa" instruction tells the assambler to include in the assembly the contents of the file named in the "include" instruction. In en assambly listing, linas of coda brought into the listing via an "include" instruction ere prefixed with e latter "C."

Thus, in the record create, read, undete program, the instruction "include doscall.asm" tells the assembler to include at thet point ell of the code in the file named doscall.esm. f creeted this file so that f would not have to remember the function number for each of the 30 or so DOS functions. ft assigns mnemonic nemes to them so f cen refer to them by neme in the main

program. The "macro" processor built into the essamblar is another productivity tool for writing assembly language code. It allows you to define, for the duretion of en assembly, new instruction codes that stend for several or meny lines of code thet may be repeated in the body of a progrem. The included file, "doscall asm," in the record creete, reed, updete program conteins the definition of a macro named "doscall," which stends for the code necessery to invoke e DOS function. In an assambly listing, lines of source code created by the mecro processor are prefixed by a plus sign (+).

In eddition to the use of the include end mecro fecilities of the IBM Personal Computer Macro Assembler, the record create, read, update program and the floating-point operations program were written with the assistence of e structured essembly preprocessor, which enables the programmer to use structured programming constructs such as if-else-endif. repeet-until, and while-endwhile. The preprocessor converts these constructs into the eppropriete assembly code, relieving the programmer of just a little bit of the burden of assembler language programming.

These structured assembly pseudoinstructions show up as comment fines beginning with xif, xifcond, xelse, xendif, xrepset, xuntil, xwhile, end xendwh. The code generated from them by the preprocessor follows them, but other than the fact that the ganerated code lines do not contain comments end the fact that lebels generated by the preprocessor all have the form x9999x: (where 9999 is a 4-digit hexedecimal number), there is no wey to distinguish the code generated by the preprocessor from the rest of the code.

All of the programs were essembled using the fBM Personal Computer Macro Assembler (version 1.00) on e 128K PC with the 10-megabyte hard disk expansion chassis running DOS 2.0. Programs were linked using the DOS 2.0 version of LINK. except for the record create, reed, update program, which had to be linked with the DOS 1.1 version of LINK because of problems encountered with the 2.0 version. Finally, the .COM files for ectual execution were creeted using the DOS 2.0 version of EXE2BIN. -Louis I. Cutrong, Ir.

preprocessor converts constructs into the appropriate assembly code, relieving the programmer of just a little bit of the burden of assembly language programming.

Louis J. Cutrone, Jr. provided our assembly lenguege routines. He consults in the aree of microcomputer system design and programming, specializing in the IBM Personal Computer, and recently. he teught a class in IBM Personal Computer Mecro Assembler Languege Progremming. Dr. Cutrona is in the process of developing several utility programs for the fBM PC, including the structured assembler preprocessor program mentioned in the sidebar on assembly languege. You can contect him et (201) 447-3270.

```
Figure 11: String concatenation in assembly language.
                        This program makes use of another of the 8088's powerful instructions:
The string move instruction ("move") and the repatition prefix
                         ("rap").
                        The string move instruction causes the character located in the data segment at the offset specified in the source index register (SI) to be copied into the satts segment at the offset specified in the destination index register (DI), following which the source
                         index and the destination index are both incremented by 1.
                        The rapatition prafix, which is related to the loop instruction,
                        The repetition prefix, which is raisted to the loop instruction, parforms the following operations: If the current value of the count register is such, stips the instruction to which it is count register. It is such as the count register is not marrowtion. If the current value of the count register is not zero, executes the string primitive instruction and than subtracts I from the current contents of the count register.
                        The nat affact is that the "rep" prafix causes the repeated assection of the atring primitive instruction, the number of repatitions being datarmined by the number stored in the count register (CX) when the repatition starts.
                        segment ; Identifies the start of a logical segment of assemblar cods.
assume cs:cssg,ds:cssg,ss:cssg; This is what the assemblar needs to know to address data.
                        pro
                                                                    :Locate data area after code, but declare it first.
                                       "This is a string"
                                       "The special symbol "s' stands for the current value of the jlocation counter, a value often represented in other sessemblers by the special symbol ""
"This is a longer string with lots of words in it."
           langth_a$ equ
           langth_b$ equ
                                       $ - b$
lsngth_a$ + lsngth_b$ dup(?)
                        ora
                                       100R
                                                                    Code starts bere for a .COM file
         initializer
                                                                    ;Sat the direction flag so that the string primitives
                        cld
                                                                    ;will work from lower to higher memory locations.; If we had set this flag to 1, using "std", then the setring primitive instructions would decrament the ;source index and destination index sech time instead
                                                                    ;of incrementing.
;Sat number of times to repeat the loop
                                       cx,10000
                        mov
         naxt_x:
                        MOV
                                       AV . CY
                                                                    ;Save the current value of the loop counter into the A-register.
                                       si.offsat as
                                                                    ; Put the offset of as in the data segment into the source index.
                                                                    Put the offset of c$ in the extre segment into the destination index.
                        POV
                                       di.offsat c$
                                      cx,lsngth_as
                                                                    Put the number of characters in string as into the count register.
                        BOV
                        rep movab
                                                                    ;Copy the characters from as into cs
                                                                    ; Put the offset of b$ in the data segment into the source index
                        BOY
                                       si, offsat b$
                                                                    The dastination index is already pointing to the next character
in cf because that's how the preceding 'rep moveb' left it.
Put the number of characters in string b$ into the count register.
;Copy the characters from b$ into c$
                        HOV
                                       cx,langth_b$
                        rep movab
                                                                    ;Ratriavs the current value of the loop counter, ;and rapeat the above until the counter hits zero.
                                       cx,ax
                        loop
                                       naxt_x
                        int
                                       20H
                                                                    Return to DOS
                                                                    ; Idantifias the and of the logical segment named "cseg"
                        and
                                       initialixe
                                                                    ;Tells the assumber where execution is to begin.
```

```
Figure 12: A record/create/read/update program in assembly language.
```

```
include doscall.ssn
include fcb.asn
CSEC
         segment
         assume
                   cs:cseg,da:creg
                   200H
                             <0, "TEST
                                          ","DAT">
                                                         Define PCB for disk file.
diskfile
                             "Modified"
new_dsts
                            # - new_data
132 dup(" ")
length_new_data equ
                                                         :Initialize to blank as BASIC does,
record_area
                   đb
         orq
                   100H
initialize:
                                               ;Specify location of program's input/output buffer
;Create a file named "TEST.DAT"
;Set logical record length to 132
         doscall set_dta,record_srea
         doacall create_file, diskfile
mov diskfile, lrec1, 132
                   bx,bx
                                                ;We will use BX as the record number counter
x0001x:
                                                ; Next value of record number counter
                   diakfile.relrec,bx
                                                ;Set record number field in FCB
          doscall random_write, diakfile
                                                :Write contents of record_area to file.
xuntil bx,ae,100
                   bx,100
                   x0001x
          inae
                                                :Zero BX for use as counter for reading back
          xor
                   bx,bx
exrepeat
                                               :Next value of record number counter
                   diakfile.relrec.bx
                                               ;Set record number field in FCB
;Read contents of record into record_area
          doacall randon_resd, diskfile
; xuntil bx, ae, 100
                   bx.100
                   x0002x
          inae
          doscall close file.diakfile
                                                :Close the file
:Part 2 - modify and rewrite records
                                                ;Make string primitives increment
                                                Open the file
|Set logical record length to 132
|Zero BX for use as counter for records modified
          doacs11 open_file,diakfile
mov diskfile.lrec1,132
;xrepeat
                                                Next value of record counter
          inc
                                                (Call subroutine to read record number in BX
                   read
                   si,offset new_data
di.offset record area
                                                Point to input/output area
                   cx,length_new_data
                                                :Tell how many characters to move
          mov
          rep me
                  sh
                                                (Copy characters into record area (Cal) subroutire to write modified data
                   write
;xuntil bx,ae,100
                   bx,100
          inse
                   x0003x
          doacsll close_file,diskfile
                                                ;Close the file
          int
                   20E
                                                :Return to DOS
;Subroutine to read the record specified in BX read proc near ;Tell assembler this is s NEAP aubroutine
                                                ¡Set the record number to be read
¡Read it in
          TOV
                   diskfile.relrec,bx
          doacs11 random_read, diskfile
          ret
                                                ;Return to caller
read
          endp
                                                ;Tell assembler that's sll for this subroutine
;Subroutine to write the record specified in BX
write
         proc
                                                ;Tell
                                                      assembler this is a NEAR subroutine
                   diskfile.relrec.by
                                                Set the record number to be written
          doacall random write, diskfile
                                                :Write it out
                                                Return to caller
write
          endp
                                                ;Tell assembler that's all for this subroutine
cseq
          enda
```

end

initialize

```
rogram etring_concatenation
                 x : integer;
e.b.c : letring(80);
                      := 1 to 10000 do
                             hie ie a etring';
bis is a longer etring with lots of words in it';
Figure 14: The read/write modify program in Pas
            rogrem records(input,output,fyla);
              grem records:sug-
et bell = 7;
e rec = packed record
dete : letring(132);
                r i byte;
fyle : file of rec;
               ssign(fyle, 'test.dat');
yle .date := 'Creetion ';
                write (fyle);
                or a := 0 to 99 do put(fyle);
              closs (fyle);
eriteln (output, chr (bell));
            writes now town; or the ill if reset(fyle); for x := 1 to 99 do get(fyle); close(fyle); writeln(output.chr(bell)); fyle.mode := direct; { ellows rerreset(fyle);
             for a 1 0 to 99 do
                      eck (fyle, a) ;
                   get(fyle);
get(fyle);
fyle det := 'Rodified';
seek(fyle,a);
put(fyle);
                   e(fyle);
Figure 15: String concatenation in FORTH.
Figure 16: Record Management function in FORTH.
                 i- 129
[ 06/29/83 - PC Magasine benchmark programs, in M
                                    tts, read, spdats ) | TANE |
id STRINGS word met )
STRANT FILE-NEW ( File area to start in neet blk )
TRANT FILE-NEWS ( File area to start in neet blk )
```

ecross the street from the World Trade Center in New York's financial district. Wisan can be reached at [212] 608-4000.

Notice the working storage section for this version of the string concatenation program (see Figure 9). It requires you to specify the length of each string as well as its contents.

The read/write/modify program (see Figure 10) gives you an idea of how COBOL programs begin to look in a business environment. The FD in the data division describes the records to be creeted and used by the program.

HERE IS a certain undefinable way in which a language meshes with your personality.

ASSEMBLY

The program shown in Figure 11 makes use of one of the 808% pour liaistructions. The string more instruction (move) and the repetition prefix (repl.) The string move instruction causes the character located in the data segment at the offset specified in the source indox register [SI] to be copied into the extra segment of the offset specified in the dister specified and the dister specified on the dister specified in the disternation index are both incremented by 1.

The repetition prefix, which is related to the loop instruction, performs the following operations: If the current value of the count register is zero, it skips the instruction to which it is prefixed (in this case, "movab"), and passes control to the next current instruction. If the current value of the count register is not zero, it executes the string primitive instruction and then subtracts I from the current contents of the count register.

The net effect is that the "rep" prefix causes the repeated execution of the string primitive instruction, the number of repetitions being determined by the number stored in the count register (CX) when the repetition starts.

The final assembly language program (see Figure 12) uses two included files. one that makes DOS calls easier, end one that helps the programmer in satting up file control blocks.

Pascal

Pascel's string concatenation operator, CONCAT, is straightforward (see Figure 13). Note that the length of the strings must be declared in the beginning of the program.

The read/write modify program (see Figure 14) uses two file modes, sequential and direct. The files are created and read sequentially and then modified in direct or random mode.

FORTRAN

Edie Windsor, who provided our FOR-TRAN routines, is a netive of New York City who worked in various capacities for IBM over a period of 16 years. She has been involved with FORTRAN since her early research in 1956 at NYU, where she worked on iterative solutions to 4th order differential equations. A year later she authored the NIM program that IBM distributes with updates to 704 FORTRAN. At IBM, she was a Senior Programmer

in the Systems Development Division. specializing in specification design, implementation of systems, and language processors, as well as architecture systems requirements, product planning, end strategies. She has extensive experience with FORTRAN on the IBM 704, 709, 7090, 7040/44, the 360 series, the 370 series, and others.

Edie subsequently meneged en IBM group responsible for FORTRAN, COBOL, and Algol standards; and wes responsible for IBM's Corporate Languege Strategy.

In FORTRAN, strings are handled as arrays of individual charecters, which accounts for its low performance in the benchmarks (see Figure 22).

The file handling program shows the detailed specifications that FORTRAN requires in order to process them properly

```
Figure 17: APL string concatenation.
```

```
♥ PEGES; C: N
£12
[2] LOOP:+0x10000:N+N+1
     A+ THIS IS A STRING
[32
     Re THIS IS A LONGER STRING WITH LOTS OF WORDS IN IT.
E42
[52
     Cen. B
163 +LGOP
```

```
Figure 18: APL floating point.
9 PROB4 N
  UB+Ne1234.56
  UC+Np78.9
  UAFUBXUC
```

VA+UB+UC Figure 19: String concatenation in dBase II.

[4]

```
dBasa II atring concatanation
   Note that all memory variables must be assigned a value before they can be referenced. "atarting..." + chr(7)
aat talk off
STORE 1 TO X
DO WHILE X < 10001
   STORE 'This is a string' TO A
STORE 'This is a longer string with lots of words in it.' TO I
   STORE A+B TO C
   ENDDO
CIPAD
aat talk on
? "finished!" + chr(7)
```

Figure 20: dBase II file update program.

```
* dBasa II file update program.
* This program wass a pra-defined 132 byte
* file to be created, read and updated.
USE TESTOR
? "atarting..." + chr(7)
aet talk off
STORE 1 TO X
DO WHILE X < 101
APPEND BLANK
   REPLACE FIELDI WITH X
   STORE X+1 TO X
   ENDDO
CLEAR
 USE TESTDE
 DO WHILE X < 101
   STORE FIELDI TO A
   CRID
   ENDDO
```

REPLACE FIELD2 WITH "Modified" STORE X+1 TO X SKIP ENDDO CLEAR

set talk o ? "Finiahadı" + chr(7)

SE TESTE

STORE 1 TO X

DO WHILE X < 101

```
Figure 21: PL/I programs.
declare 1 fixed binary;
declare 8 character (16);
declare t character (32
declare r character(48);
do 1 = 1 to 10000;
s = 'This is s etring';
t = 'This is s longer string with lote of worde in it';
test6: procedure optlone(main);
declere i fixed blnary;
declere f file;
declere record cheracter(132);
record = "1; /* ell blenks */
open file(f) title('PCMAG.DAT') record output;
do i = 1 to 100;
write file(f) from(record);
```

close file(f): open file(f) title('PCMAG.DAT') record input: i = 1 to 100; reed fils(f) into(record); close flle(f);

open flle(f) title('PCMAG.DAT') record output;
do i = 1 to 100;
record = 'Modified';
write flle(f) from(record);

close file(f): end test6:

Figure 22: String concotenation in Fortran.

PROGRAM STRING CHARACTER A*17, B*49, C*67 DO 40, I=1,10000 A = 'This is a string.'

"This is a longer string with lots of words in it." WRITE(C, '(A,A)'),A,B STOP

Figure 23: File create/read/update in Fortran.

PROGRAM FILEHAND CHARACTER*66 B,C, FI*10 CHARACTER INIT DIMENSION B (101) , C (101) INIT - 'Y'

FI = '#5:TESTDAT' OPEN 5,FILE =FI,STATUS='NEW',ACCESS='DIRECT', 1FORM='UNFORMATTED',RECL=132 DO 40, I=1,100

WRITE(5, REC=1) INIT CONTINUE

CLOSE (5. STATUS='KEEP') OPEN 5, FILE "FI, ACCESS" DIRECT', FORM "UNFORMATTED', RECL=132 DO 50, I=1,100

READ (5, REC=1) B(1),C(1) CONTINUE

CLOSE (5) OPEN 5, FILE =FI, ACCESS='DIRECT', FORM='UNFORMATTED', RECL=132 DO 60, 1=1,100 B(I) = 'MODIFIED'

60 WRITE (5, REC=1) B(1),C(1) CLOSE (5)

PAUSE OPEN 5, FILE =FI, ACCESS='DIRECT', FORM='UNFORMATTED', RECL=132 READ (5, REC=20) B(101), C(101)

WRITE (*, '(A) ') B (101) CLOSE (5)

STOP END

(see Figure 23). API.

Bob Lee provided our APL routines. He is a research psychologist who specializes in public opinion and consumer research. He first became acquainted with APL while performing survey studies in the late 1960s, and spent 20 years using the language as a communications researcher at IBM. He has developed courses in computers for executives in the educational field, and has taught numerous classes at IBM Systems Research Institute, NYU, and elsewhere.

APL, the language with all of those funny symbols in it, sure saves your typing fingers if not your eyes.

The Floating Point Benchmark in APL does not require looping (see Figure 18). The header for the program defines this as a function that takes one argument, in this case N, which is the number of times the pair of floating point operations is to be performed.

Line 1 creates a vector named VB with N elements, each with a value of 1234.56. Line 2 makes the VC vector, with N elements, each valued at 78.9. The two vectors are then multiplied element by element in Line 3 with the resulting vector of N products assigned to a new vector called VA. In Line 4, the vector VB is divided by vector VC and assigned to VA again. Note that APL uses an "x" for multiplication: the """ is used for exponentiation.

API, calls concatenation "catenation" for some reason. We will need to set up a loop, as used in the empty loop benchmark (see Figure 17).

The counter, N, is set at 0 in the first line. The second line, labeled LOOP, works in the same way as the empty loop beochmark. Here, though, instead of using the labeled line OUT as an escape, we simply direct the program to the nonexistent line 0 when 10,000 is less than is true. (This is the obverse to the BASIC and FORTRAN operations which continue until N is greater than 10,000.)

Line 3 creates the first character string and assigns it to A: Line 4 the second string for variable B. in Line 5, the two strings are catenated by use of a comma and assigned to variable C. Line 6 branches back to LOOP.

FORTH

FORTH'S unique flevor can be seen from the figures representing our benchmarks.

Other then empty loop, string concatenation may be the most recognizable in terms of deducting how the progrem works without a working knowledge of FURTH. See Figure 13. Remembering to read right to left, the surpreding task is most collection to left, the surpreding task is most collection. In FURTH. MMSS version of the progression of the collection of the collection of the collection of the collection of the collection. In SIGN 18 of the Collection of the collection of the MSDOS (FURTH is an operating system complete unto itself), the record menegment functions are complete (see Figure 16).

■ C

Randall Swan, who provided the C coulines shown below; a present and founce of the C-Tean, a counting from the half a design products, including a C screen editor, a package to translate B-SGC into C, and a special counting the county of the C state of the C st

dBase II

dBose Il's syntax comes from some of 10,000 times is not whet it was d the best features the structured lengueges for et all (see Figures 19 and 20).

have to offer in terms of clarity. There is no GOTO. The sample programs are utterly readable and are probably closer to English than any other lenguege represented. Note that the language does not contain any count-limited looping ehility, but must increment e variable end check its value through use of the WHILE statement. Thus, there is no such thing as an "empty loop" in dBose and there is no equivalent benchmark. Similarly, there is no way to declare or access an array, and, consequently, no table lookup benchmark. From the performance tests, it is obvious that asking dBase to do something 10,000 times is not what it was designed

Figure 24: C language concatenation program.

```
main()
                Example 4
                                Without pointers is slower.
                String concatenation with 10,000 iterations
        14
{
       char strl[18]:
                        /* Declare stringl as an array of 18 characters
        char str2[50];
                        /* Declare string2 as an array of 50 characters
        char str3[80];
                        /* Declare string3 large enough to hold both
        int i=10000;
                        /* Initialize i for 10K loop
        while (i--)
            strcpy(strl, "This is a string.");
            strcpy(str2, "This is a longer string with lots of words in it.
            strcpy(str3,str1);
                                    /* String copy strl into str3.
                                    /* Concatenate str2 onto str3.
            strcat(str3,str2);
                                  Pointers used for strings is faster.
 main()
                 Example 4a
                 String concatenation loop with 10,000 iterations
         char *strl:
                         /* stringl is a pointer to char text
                                                                           */
         char *str2:
                         /* string2 is also a pointer to char text
         char str3[80];
                         /* string3 is an char array for concatenation
         int i=10000;
                         /* Index count starts with 10K & steps downto 0 */
         while(i--)
                 strl="This is a string.";
                 str2="This is a longer string with lots of words in it.";
                 strcpy(str3,str1);
                                        /* String copy from strl to str3 */
                 strcat(str3.str2):
                                         /* Concatenate str2 onto str3
         )
```

Figure 25: C language direct access disk I/O.

```
Example 6
                          Direct Access Disk I/O.
        There are three phases to this program to demonstrate
                 direct access (random access) disk I/O in C.
                 Lattice extends the UNIX view of buffered file
                 control but is fundamentally the way most
                 non-UNIX C operating systems, ie. PC-DOS, do it.
                 Social tradition of these non-UNIX compilers is the only thing that deems C I/O so similar
                 and has eased the portability of source code,
                 but does not guarantee it by any means.
                 There is no standard of adherance for I/O in C.
                 only tradition dictates, and it is a strong one.
                 The 'fseek' statement is how record positioning
                 is controlled relative to the beginning, the end,
                 or the current location.
                 Only one record of the datafile is kept in the
                 program memory at any time.
        Phase I creates 100 blank filled 132 byte records onto disk.
        Phase II reads all 100 recs back from disk.
        Phase III reads in a record & then writes it back out,
                  one record at time for all 100, just as
                  if an update to the record were performed.
*/
                 "stdio.h"
#include
                                   /* Standard Library for Disk I/O
main()
        char rec[133];
                                   The record is made of 132 blanks plus
                                   a terminating byte. */
        FILE *fp;
                                   Pile pointer for buffered (level 2) I/O.*/
        short if
                                   This little guy is used to count to 100 */
                The Make String function creates an indicated # of bytes */
         strmak (rec, ' ',132);
         /* Create the datafile or bitch.
if((fp = fopen("TEST.DAT","w")) == NULL)
{ puts(" Error: Can't create file "TEST.DAT' for output.");
                 exit();
                                   /* quit out, can't stand it anymore.
         else
                                            Write 100 blank records
                          Phase I
                                                                                */
                 for ( i=1; i<=100; i++)
                                                   /* Write'm out baby!
                          fputs (rec, fp);
                                                  Close down the disk file
                 fclose (fp);
         /* Reopen datafile in append mode or bitch about it.
if( (fp = fopen("TEST.DAT","a")) == NULL)
                                                                                */
                 puts(" Error: Can't open file 'TEST.DAT' for I/O.");
                 exit():
                                   /* quit out, that's all she wrote folks */
```

End Statements

Even though you didn't get to choose your own native

tongue, you can choose one for your PC.

Is there a "best" language? Probably not. Some readers might criticize our benchmarks for not being "real-world" examples, but that was not our intention; we simply wanted to show similarities and differences in syntax and structure among the languages presented.

It's impossible to do an article such as this and not draw some conclusions. Without getting into overly complex and controversial areas, it's obvious that there are some very fast compilers in our sampling. There is also a middling fast compiler and e dead-slow interpreter. Some of dBose II's times sparked comments ebout boping the sun would stay out long enough to get an eccurate reading from the sundial. Does this mean that we're going to give up dBase II for all those in-house filing and list management chores? Not on your life. dBose II's strong suit is in-line processing of records, and selecting end indexing them according to your needs. It's also pretty good et handling screens. They weren't in the benchmark test because all of the pure programming languages would have fallen miserably short in ease of development of a given application, even if the end result ran many times faster. There are many occasions when slow is fast enough.

In the same vein, witness the unsinkable BASIC interpreter. Forget operating systems. Forget snazzy spreadsheets. Hang up your modem, and, for that matter, junk your PC. The real hero of the personal computer revolution is BASIC, Microsoft's prodigal program has coaxed out the programmer hidden within so many of us that it is and will continue to be an integral part of the personal computer scene for many years to come. True, BASIC is slow compared to the compilers, but not leughably slow. It will probably hold off LOGO as the interpretive language of choice for another 3 to 5 years, Okay, it's inelegant and the line numbers are a pain. It lecks

control structures and records. But you can bang out a quick and dirty program to reformat your spreadsheet files, filter offensive characters from a word processing document, or write e game to amuse

your kids or yourself.

Style is important when you look at a language. Flowery phrases thet seem netural in Spenish simply sound stupid in English. And so it is with programming languages. Reviewing the sample progrems. Pascal is probably the most elegant and cleanest, followed by your choice of the other structured languages-PL/I, C and dBose II. Pascal's deadly flaw, though, is its lack of standardization. FORTRAN's prose is probably the most turgid, while COBOL certainly wins the prize for longwindedness. APL is in a class by itself for economy of expression, but it's too abstract for many people, LOGO has a charming simplicity, but MAKE end BUT-FIRST and some of the other words sound a little contrived to my ear. The best thing about LOGO is that powerful ideas such as recursion and list processing are ex-

. HE REAL hero of the personal computer revolution is BASIC.

pressed simply and economically.

FORTH, as other function-oriented languages, gives you the ebility to code up some pretty complex stuff and reduce it to a single word. Better still, that word becomes part of your vocabulary with no further effort on your part-no libraries, macros, compiletions, or assembly. On the other hand, you're manipulating a hypothetical processor in FORTH. The stackoriented mechine doesn't really exist. While this is true to an extent with other languages (you learn to think like the language's syntax checker, not the actuel computer), it's far more evident in FORTH. Assembly, meanwhile, couldn't be more ettuned to the processor.

Of course, the programmer's style bas a lot to do with the utility of the end result.

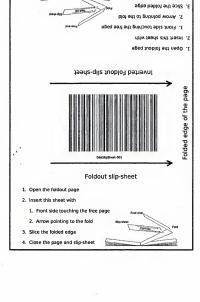
The C programs in this article, for example, are as beavily commented as the assembly programs. While not strictly necessary, they allow an utter neopbyte to read the C programs and decipher how they work. No language is so selfdocumenting that it can't be improved with comments. Comments may range from lengthy dissertations down to a single character or even a punctuation mark. Making the program look easy is the mark of an accomplished programmer. Beginners tend to start writing programs before having fully analyzed the problem. Then, when things don't work, they patch and repatch the program until the listing resembles e tengle of speghetti. While no language encourages such ection, some, like BASIC, make it inviting, while others, like Pascal and C, discourage it.

Okay, you say, they've all got strong points and weak points, but surely we have some recommendations? You bet. Don't give up BASIC if you program for your own pleasure or you do graphics on the PC. If you want to see the light bulb come on over the head of a programming neopbyte, let him start with LOGO or APL. PL/I, COBOL, and FORTRAN translate with relative ease to minicomputers and mainframes, while C best makes the transition to minicomputers running UNIX, It's also quite portable among personal computers. Portebility questions aside, we can't see any reason why you would want to learn COBOL or FORTRAN for use on your PC. Pascal is easy to learn, although not nearly so as BASIC. So long as the implementation you choose does what you want, enjoy. Don't expect much in the way of compatibility, though, if you change from one compiler to another. Don't feel guilty if you don't like Pascal. Meny converts would beve you believe thet it's the only solution, but frankly, the p-System is ponderous and inelegant.

Once you choose a new language, you may have trouble figuring out whether it is eleveting you to new heights of creativity or constraint. You can't own all of the great cars in the world, you can't even read all the great books. You can't know all the great computer languages, and each door that you open closes a bundred others. Choose carefully and know your needs and abilities. And once you've decided don't look back.

ance

TEST 4 TEST 5		TEST 6 File occess		Size of run time support	Internal editor	Compile time	Overall ease of use	Reader		
TIME seconds	SIZE	TIME in seconds	SIZE	TIME in seconds	SIZE	module (for eoch test)	(yes/no)		1-difficult 5-easy	Cord Numb
	1408 bytes	22	1408 bytes	39	1408 bytes	31744 bytes	No	40 seconds	4	888
8 inutes)	256 bytes	1.58 (minutes)	258 bytes	0.40	384 bytes	16768 bytes	Yes	Not epplicable	5	
7	162 bytes	1.1	142 bytes	44.2	433 bytes	Not applicable	No	40 seconds (average)	1	685
inutes)	5888 bytes	3.49 (minutes)	5888 bytes	28.22	11648 bytes	16081 bytes	No	1 minute	3	
5 inutes)	36224 bytes	.5	38096 bytes	28	50432 bytes	Not epplicable	No	53 seconds	3	
9	916 bytes	3.0	154 bytes	16.4	169 bytes	18200 bytes	Yes	Not epplicable	4	884
	7880 bytes	4	7880 bytes	13	8192 bytes	Not eppliceble	No	45 seconds	3	683
6	393 bytes	8.48	352 bytes	Not aveilable	Not availeble	18000 bytes	Yes	Not epplicable	5	682
6	14336 bytes	12.41	14338 bytes	28.4	11778 bytes	Not applicable	No	30 seconds	3	661
34 inutes)	512 bytes	Not epplicable	Not applica- bie	58	640 bytes	23168 bytes	Yes	Not epplicable	5	880
5	Not epplica- ble	0.02	Not epplica- ble	Not applicable	Not applica- ble	Not applicable	Yes	Not eppliceble	3	879



4. Close the page and silp-sheet

J. Follow instructions on the other side

Inverted Back



Back

1. Follow instructions on the other side

A Guide To Language Perform

Speed and Size of Object Module

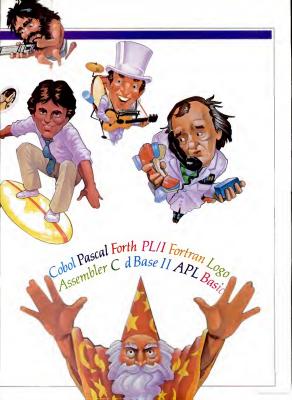
	1	TEST 1 Looping		TEST 2 Add integers		TEST 3 Flooting point		Si
Language Name ond Manufocturer	List Price	TIME in seconds	SIZE	TIME in seconds	SIZE	TIME in seconds	SIZE	in
BASIC Compiler	\$300	0.2	1280 bytes	0.6	1280 bytes	14	1280 bytes	22
Advanced BASIC (BASICA) Microsoft 10700 Northup Way Bellevue, WA 98004 (206) 828-8080	\$60	5	128 bytes	17	128 bytes	1.40	128 bytes	1. (n
Assembler	\$100	0.1	7 bytes	0.4	34 bytes	7.1	532 bytes	3.
COBOL	\$700	3.3	5632 bytes	2.31 (minutes)	5760 bytes	2.56 (minutes)	5760 bytes	1. (n
FORTRAN IBM Corporation System Product Division P.O. Box 1328 Boca Raton, FL 33432 (800) 447-4700 (800) 322-4400 Illinols (800) 447-0980 Alaska, Hawaii	\$350	8	35840 bytes	1.01	35968 bytes	23	35841 bytes	2. (n
MMS FORTH System V2.0 Miller Microcomputer Services 61 Lake Shore Rd. Natick, MA 01760 (617) 653-6136	\$249.95	0.3	22 bytes	4.3	46 bytes	26.9	126 bytes	12
Lattice C Compiler Lifeboat Associates 1651 Third Ave. New York, NY 10028 (212) 860-0300	\$500	2	7552 bytes	4	7552 bytes	1.20 (minutes)	8960 bytes	32
PC Logo Harvard Associates 260 Beacon St. Somerville, MA 02143 (617) 492-0660	\$199.95	2	53 bytes	1.28	157 bytes	3.28	265 bytes	2.
PL/1 Digital Research Inc. 160 Central Ave. Pacific Grove, CA 93950 (408) 649-5500	\$750	.33	14848 bytes	.36	14336 bytes	16.38	14336 bytes	7.
dBase II Ashton-Tate 10150 West Jefferson Bivd. Cuiver City, CA 90230 (213) 204-5570	\$700 (local dealers may vary)	Not applicable	Not applica- bie	17 (minutes)	258 bytes	21.31 (minutes)	384 bytes	1: (n
APL*PLUS/PC STSC, Inc. 2115 E. Jefferson St. Rockville, MD 20852 (301) 984-5000	\$595	0.1	Not applica- ble*	8.4	Not applica- ble	14	Not applica- ble	21



A Guide to Language Performance

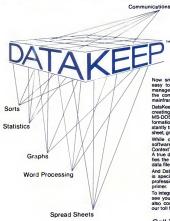
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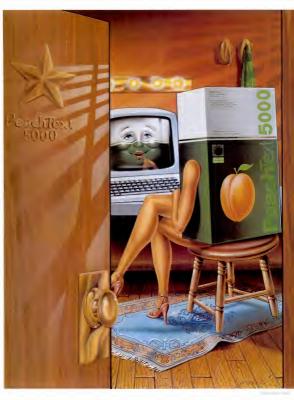
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Volkswriter, Snooper Troops, and 1-2-3 were not products of a moment of inspiration; they were the first culmination of three rambling, eclectic careers.

ON THE ROAD TO SOFTWARE STARDOM

Some of Hollywood's silliest, campiest scenarios have been cinematic attempts to explore Creativity (with a big C). You heve the "Moment of Inspiration" scene in which Cary Grant, as Cole Porter, listens to the tick, tick, tock of the clock in his study, frowns, appears constipated, suddenly gasps in full lightbulb-over-thehead Eurekadom and sits down to compose "Night and Dey". Then there's the "Tortured Artiste Struggles." Merle Oberon, playing the French writer, George Sand, turns to Cornell Wilde's schnook Chopin in A Song to Remember, and snipes: "Discontinue that so-called polanaise jumble you've been playing for days!" Don't forget the ever-popular Artas-Transcendence scene whereby the camera reverently pans from George

Gershwin's piano keyboard up into the clouds in Rhupsody in Blue. Presumably, when Hollywood discovers softwere euthors, we can look forward to Busby Berkeley-like overhead views of whirling floppies and shots of function keys soaring into the stratosphere.

Part of the problem is that exis of cracity—be they of the traditional or binary variety—are usually dependent on aschunsers, nonvivani fectors as such unsers, nonvivani fectors as the usually dependent on aschunsers, nonvivani fectors as the usually dependent on the problem of the problem



"The year before I did Volkswriter, I was living out in the middle of nowhere, going into San Francisco e couple of days a week, trying to make a living as a consultant, "recalls Wilson. Now 36, Wilson, who had come to the United States in the 60s from Chile to study math at Berkeley, fooled around on lots of mainframes, and later gravitated toward New York, where bed did computer consulting work on Wall

WHILE our romantic hero was struggling to put it all together, IBM announced the PC.

Street, got involved in the human potential movement, and wound up working for the book division of the Arica Institute. Then Wilson fell in love with a Californian lady and abruptly switched gears—not to mention coasts.

Book to Word Processor

It was while our romantic hero we struggling to put it all together that IBM announced the PC in August, 1981. Since Wilson was among a fairly small number of people who had experience both in computers and in publishing, it seemed like a good idea to write a book about the PC. After signing a contract with Berkeley's And/Or Press, he beaded down to ComputerLand and bought one of the first PCs off the assembly line, and one of the first copies of the by-now-infamous Eosy-Writer 1.0. "The horrors of EasyWriter were such that I decided to write my own word processor to get the book done," Wilson said. It is perhaps an indicetor of the man's essential nerd-genius that he blithely adds, "Of course, I had to quickly learn Pascal, because there wasn't en IBM assembler available then, but since I alreedy knew a balf dozen assembly languages, that part was fairly easy.'

"At the end of 2 weeks, I knew I had a viable word processor." Wilson recalls. Then came the Moment of Inspiration: "I realized, here was the opportunity I had been looking for, and what the hell?" And/Or Press agreed to forget ebout the IBM

book and instead publish the word processor, a move that it unquestionably does not regard, since Volkswriter has sold over 25,000 copies. There followed 3 months of toothpick-holding-the-eyes-open, losity-25,000 copies. There followed 3 months of toothpick-holding-the-eyes-open, losity-25,000 copies. The followed 3 months of the following the word with an open of the holding-the-eyes open copies. Will som puts it, "In the early days of the PC, bookedy wanted to tell you anything." (The BM Technical Reference guide wasn't were not yet;) Wilson credit in his grid result of the period, but he does not provide the sold with the sold the was the contract that the period, but he does the wasness of the word of the wasness of the period, but he does the wasness of the period, but he does the wasness of the period, but he does the period was the period with the period wasness of the period wasnes

One ongoing source of fingerneil biting was the incipient entry of MicroPro's venerable WordStor into the IBM field, "Every week, we'd go down to ComputerLand, and they'd tell us that WordStor was due in the following week," recelled Wilson. One tack he took was to carve out a slightly different piece of the market. Whereas WordStar is full-featured but sometimes hard to learn, he went for ease of use every time. Another plus: Wilson's program came preconfigured for a variety of printers, whereas the first WordStar release for the PC worked only with the IBM/Epson printer. Wilson and his ledy friend decided to call the product Volkswriter, e tribute to the similarly plein-but-reliable Volkswagen. "Most of the other word pro-

cessing programs on the market had these outer-space-sounding names like Word-Stor end Mogic Wond and Electric Pencil, and we wented something down-toearth," they said (Lifetree, he name of their Monterey firm, was a deliberate spoof of Lifeboat the New York software distributor, and Peachtree, the Atlanta software company.)

The marketing of Volkswriter, according to its author, was even more nervewrecking then the programming, largely due to fears that MicroPro would blow all competition out of the water. Early on, Wilson decided that it was ebsolutely imperative to have the product ready in time for the West Coast Computer Faire in the spring of 1982, "Our booth got an enormous amount of coverage, because we were the first non-IBM word processor on the market for the PC," recalled Wilson. Lifetree also took out "a little teeny tiny black and white clessified" (see Figure 1) in one of the early issues of PC. From those two events, a star was born. As It turned out. MicroPro didn't nut WordStar on the shelves until fully 6 weeks after Volkswriter appeared.

Why was Wilson able to be first on his block? Perhaps, he modestly suggests, "it's because I was never really in the 8-bit world: in fect. I've never used an 8-bit computer. I suppose I didn't know enough to be intimidated." He also believes that Lifetree was "alweys willing to welk the extra mile" in terms of customer support and dealer reletions in an era of ebsolute cheos in the microcomputer business. The first version of Volkswriter hed e significant bug, and Lifetree bad to recall dozens of copies. "But," says Wilson, "from day one we had a fully accessible botline" (unlike MicroPro, whose motto often seems to be: "Ask Your Dealer"], Lifetree, meen-

Figure 1: Lifetree, the company founded by Comilo Wilson to morket Volkswriter, took the plunge and bought clossified space in on early edition of PC Magazine to promote what it then colled Plainwriter, a name that, fortunately, did not stick.



ROM DAY one we had a fully accessible hotline.

while, has gone on to release an international edition of Volkswriter, and to add many of the advanced features that Wilson was happy to leave off only e year and e half ago.

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My Pal, IBM . . .

Like Wilson, Tom Snyder hed one of those eelectic and rambling careers, which, in perfect fleshback, seems destined to leed to softwere stardom. As a 14year-old in Wellesley, Massachusetts, Snyder, now 33, designed digital comput-

THE relationship between kids and computers interests me not at all. What I care about is the relationship between kids and kids.

ers for fun. "At one point," he recalled. "I jotted down a couple of circuits and sent them to e gay of IBM. Shortly shrefward, I came home from school one day end found a couple of thousand dollars worth of hardware parts on the lewn that had been dropped of by a truck, with a note from IBM that said something to the effect of, II you design anything else, think of us." Ever since then, I've kinda hed e soft soot for IBM."

But, other things intervened: "To be brutally frank, I discovered adolescent sex and graduated from that whole nerely thing." Snyder went on to major in French at Swarthmore, join a rock band (the recorded on Capitol in the late 1986s), get a master's in education at Lesley Coulombridge, Massachusetts, and join the staff of the Shady, Hill alternative school in Cambridge as a science and music teacher.

Early in his teaching carner. Snyder invented a primitive, computerized robot as a teaching aide. The robot became so famous on the education circuit that in 1978 Parker Brothers expressed an interded of the control of the control of the become a notionica. Tom Snyder ancdote, he somehow managed to "forget" what day the appointment with Parker Brothers was scheduled, and to arrive in the right place of by late. Snyder now says that he had one of those rare epiphonies that the best of the control of the control of the domin. In his case, It was making sure that he didn't get involved in commercial success be wesn't emotionally prepared to handle. On the wey home from the nonexistent meeting with Parker Brothers, Sny-

der bought a Radio Sheck computer. Before long, of course, he began to bring the computer to school and to play with it menically between classes. And also before long, it occurred to bim their could be a mersy-lesson closer motod. "I hed no intention of writing educational software—none at all!" Snyder insists. "And the reletionship between kids and more computers interests me not et al. What I care about it the reletionship between mines, the group dynamics ere important. I realized I could use the computer to enhance that."

Thus Snyder drifted into writing sames their demended cooperation and collaboration smong the kids in the class. He did this chiefly by heving more information flash on the screen than any one child could hendle. While one kid would write down, say, a clue to solving a problem about the ocean, the other kids would have to weak the screen for the next clue, and everyone would have to shere clues to get the answer.

Another Snyder premise was thet kids should welk evey from the game plenning and enticipating what they'll do when they resume the game. "I wented to have the equivalent of a "freeze button' to give the kids—in terms of formal pedegogy, a chence to digest what they vie learned and to streegize." says Snyder. "You don't get that in an arcade game, although ve often thought that if Pac-Man were slowed down, it misht be really interestine."

Fiction as a Vehicle

Using these teeching insights as the basis of his softwere design (as opposed to setting out specifically to design e game). Snyder put together a series of problemsolving classroom games on the themes of geglogy, geography, energy, end other science-related topics. The classroom series was sold to McGraw-Hill for use on the Apple and TRS-80 computers end is currently in use in schools across the country. (The series hasn't been released on IBM simply because IBM has yet to make serious inroads into schools.) Meenwhile, Snyder ecquired en IBM (on which he now does all his designing), end set off to write an even more elaborate educationel

game for the students of another Sbady Hill teacher, Ann Waddington.

The result was the Snooper Troops mystery game series: Case #1. The Granite Point Ghost, and Case #2. The Case of the Disoppearing Dolphin. As with the earlier classroom series, the games emphesize cooperation and teach useful skills, from note taking to deductive reesoning. However, these are specifically designed for the home merket, end the "geme element is king" bere. Children get to play detective, race around e computer graphics town in a "Snoopmobile," take "Snoopshots" of suspects, arrange a rendezvous at a strategically placed telephone booth, search en on-line computer datebase for clues about the goings-on in town, grill witnesses, and generally heve a pretty exciting time, sons violence, sexism, and/ or mindless joystickery. The games, elong with their latest follow-up, In Search of the Most Amozing Things, which teaches kids to write music, read meps, fly a hot air balloon, and pegotiete with eliens insteed of zapping them, beve been hailed es a breekthrough in kids' software.

By now, of course, Snyder's Moment of inspiration had been meny years in the making. The germ of the Snooper Troops idea was sold to e small Cambridge firm called Spinnaker, which was beginning to go after the home merket. At that point, the serious debugging began. Continuelly testing the software on the Shedy Hill kids

FICTION
resides in a different
part of my brain, and
things stay put there.

yielded all kinds of insights and changes; of instence, Supérier realization that, "It's better to let the kids solve everything." Where the games used to ledp per thing." Where the games used to ledp per to led per the games was to led per to led per the games was to figure out the ley of the land from its individuel sectors. (Somewhere along the way here. Ann Waddington and Ton Styder got married, and Snyder, had a papersetty conquered his fear of success, formed Tom Swider Productions. Snyder designs the basic shell of the programs and hise professioned wither of children's mysteries to pen the actual polts of the games. The part that makes you lose weight," according to Snyder, "is keeping the overview in one's bead the sheeping the overview in one's bead problem be solved by using fictions," as which is, "When I first design a program, I write it out in the form of a 30-page story, something that not only deep closes, and that when the sheeping the control of the sheeping that the

While Snyder programs in BASIC, working closely with the plot writers, other programmers, often culled from MT and Harvard, bone the programs into assembly language. There are usually snags along the way: "Tim not a nit-picker;" In a nit-picker; "Snyder condesses." I have e tendency to pitch the whole game out and start from scratch." Ill never forget the total disgust with which, on three different occasions in the programming of

Dolphin, the staff greeted my announcement that I had totelly scrapped the current version."

From TM to Lotus

Mitch. Kapor, president of Lotus Devalopment Corp. and designer of 1-2-3, the number one program in the BBM world, was a nerd money in high school in Presport. Long island. Kapor went on to Yakthe college nidol station. From the the worked as a deelgy in Hartford, Connecticut, discovered Transcendental Meditation, bummed around Spain with the rest of the counterstums teaching T.M. came of the counterstums teaching T.M. came the college nidol station from the protent of the contraction of the counterstum in them with had a job, and through no licit deen, so at job as a programmer.

The Moment of Inspiretion was still a ways off, however. The joh didn't last, and Kapor went on to Switzerland before he bad the enlightening realization thet TM was not going to solve all his problems. Instead he got an M.A. in psychological counseling. Alas, he soon realized thet he

could make a great contribution to the human service field by getting out of it. It was now 1978. On an impulse one dey, Kapor bought an Apple.

Asper cought in Apple.

The next day to less gay, a higher lamb the mean that the mean the mean that the mean that the mean that the mean the mean

Since the micro world was a fairly timy and incestious one back then, Xapor soon met the men who had designed VisiCalc, end joined their teem et Software Arts. It was Xapor who designed the interface for VisiTrend and VisiPlot—an endeavor that, emong other things, led to huge roy-alties. The second check he received was for something like S103.000.

Meanwhile, however, Kapor began to get restless ebout going off on bis own. (He wes disenchanted by what he describes as increasing tensions between Softwere Arts, and its distributor, VisiCorp.) He arranged to be bought off hy Software Arts,

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THE NAME

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signing a contract the he now chucklingly describes as, "containing sort of a "purloined letter." I egreed not to compete against them directly, but I snesked in a cleuse thet said it was okay, for me to design an integrated package, if they'd thought I could really pull it off, they'd never have signed it, hut they were mostly interested in my not redoing VisiPlot and selling it to Microsoft."

Kapor's time at Software Arts hed given him some fairly concrete ideas about



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the kind of environment ha'd need to begin to develop an integrated software package. For one thing, he wented to do his own distribution. For another, he realized that his own gifts as a programmer (he knows only BASIC) were far inferior to his gifts as a software designer. By early 1982, he hed managed to hook up with both programmar Ionathan Sechs and vanture capitalist Ben Rosen. Together, they founded Lotus. (The name, he insists, "has no connection with env Far East yoga positions or spiritual values or anything: I just wanted to heve e nama thet wasn't technical."

By now, Apple's Lisa, MBA's Context and VisiCorp's Vision were heeding toward the marketplece, end Kapor knew that he had no time to waste. The original concept for 1-2-3 (then code-named "Trio") wes e spreadsheet, a business graphics program, and e word processor. Says Kapor, "For a variety of reasons, we dropped the word processor. It was, number one, too hard to do. Number two, wa saw MBA, end my feeling wes thet e detehase was e more naturel expansion of a spreedsheet. So we decommissioned the word processor and commissioned the datahasa."

Kapor readily concedes that the design procass was "egonizing" and that he was 'petrified" of the competition. Still, there were comperetively few moments of true horror. "One good thing is that the program was not designed by a committee." he said. "Ion and I had a fixed amount of time. We hed a deadlina of Jenuery 1983 end we wented some time before that for debugging; we had this long list of proposad features, each of them keved according to degree of importance and difficulty of implementation," When time wes short, the pair tended to throw in lots of noncriticel but nice, easy-to-do features, such as 1-2-3's ability to print senerate headers and footers on each page of a spreedsheet.

By the same token, a number of features were sacrificed. For example, the program has a calendar that allows the user to celculate, say, what 90 days from

today will be. Kapor and Sachs wanted to include e similer clock function to celculete time but their schedule wouldn't allow it. Kapor still smarts, too, about the dropping of the word processing modula. an oversight that will presumably be remedied in some future version.

spent \$1 million advertising 1-2-3 in The Wall Street Journal, Business Week, Time, Newsweek, and the computer press.

"We want into e no-fooling-around feature freeze on November 5, 90 days before we were to ship," he recallad. "We really wanted to bulletproof it, end in hindsight, that was a good decision, too, because there were no major bugs." Another decision was to bet all tha merbles in marketing the product, since Lotus reesonebly feered that the VisiCorn name had such brand lovalty that Lotus might not be able to get people aven to look at it. Consequently. Lotus spent \$1 million in lanuary and February, advertising 1-2-3 in The Woll Street Journal, Business Week, Time, Newsweek, end the computer press.

Still another move in the company's anti-VisiCorp blitz was the wooing of dealers, "We created a tutoriel on diskit's pert of the package that the user buys-with an on-line 200-page Help facility," said Kapor. The tutorial was sent to dealers before the officiel release, both to help them familiariza themselves quickly with the package and to provide "a product that would require less support leter on." Lotus has also run 1-day seminers for some 800 deelers to help them understand the product. The only problem now. Kapor says, is that ha is under incredible pressure to come out with the software equivelent of the best-selling first-time outhor's second novel "We het. ter heve the next mirecle to ship," he edded. "And, in fact, wa do have some magic up our sleeves."

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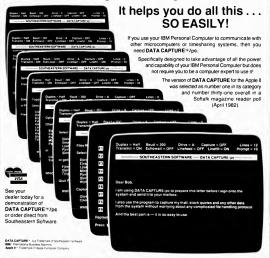
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The Age Of Independence

available today constitutes a library in microcomputer systems today. excess of 40,000 programs of every conceivable type and quality. Surprisingly, systems such as the IBM PC, lenguages most of the so-called "good" software has such as Microsoft's BASIC interpreter and been developed by individuals working BASIC compiler, the Lattice C compiler, independently in their basements.

developed by Tim Patterson, CP/M developed by Gary Kildall, VisiColc developed developer to compete with the largest of by Dan Bricklian, Microsoft BASIC devel- the Fortune 1000 companies. oped by Paul Allen and Bill Gates, TMaker pendently produced programs is on a par superior.

The Independent Edge

swer is simple. Software development is successful products. largely e solitary effort. A decade ago the

The wealth of microcomputer softwere \$2,000 to \$10,000 dollars for the necessary

The advent of sophisticated hardware and the myriad development tools-link-Whether the IBM PC operating system ers, editors, and debuggers for microcomputers-allows the individual software

There is, however, even more compeldeveloped by Peter Roizen, Lattice C ling argument in favor of individual softdeveloped by Francis Lynch, or any of a ware development efforts. Most salaried long list of others, the quality of the inde- programmers have a weekly paycheck to look forward to, plus an occasional, with anything developed for micros by though rare, bonus. An individual, worklarge corporations, and in most cases far ing Independently, has much the same motivation as a wildcat oil man. Any oil he strikes is his own, and those wells keep right on pumping dollars. Similarly, en-Why have large corporations failed to trepreneurial software developers can dominate this lucrative market? The an- look forward to years of royalty checks for

Thus, a large corporation is typically in investment required for software develop- no better position to develop microcomment was approximately ten times greater puter softwere than is a skilled individuel than required today. This amounted to a working independently. Furthermore, an nominal investment 10 years ago of per- individuel is often prepared to gamble a haps \$20,000 to \$100,000 as compared to man-year or more of his free time. A large corporation can afford no such luxury.

Software Marketing

Further, the marketing of software is a relatively new and undeveloped discipline. A number of software publishers have carried the burden of merketing the cottege industry products to dealers, dis-

tributors, end users, end original equipment manufacturers (OEMs). Currently the book publishers are scrambling to enter this field of publishing in an effort to boost revenues

It is claimed that approximately 78 percent of all bookstore seles ere to women between the ages of 20 end 45. Close to 10

percent of bookstore revenues are currently computer and computer-related books. Thus, the bookstores find themselves catering to only a segment of the potential. market for the majority of their sales while the computer books are sold to a broad market. If book dealers can edd softwere to their product offeriog, they can reasonably expect to sell to a much larger customer base. This software will probably range in suggested retail price from \$29.95 to \$495, with the mejority of the sales being the lower-priced product. There is, however, little software designed for the lower end of this price range. This pro-

vides an excellent opportunity for the

independent software developer. As for the broader marketing of software, a number of software publishers are actively publishing the intellectual properties of this modern-day cottage industry. An author provides the program, some form of documentation, a sample of the source code, demonstration software, and illustrative examples. The publisher will typically typeset and package the documentation, provide technical support for the product to the end user, advertise the product, offer it for a wide variety of machines, distribute technical descriptions to potential customers, provide catalogs, and mail royalty checks to the author-all at no direct cost to the originator of the program.



One might ask why hardware meoufecturers don't actively develop software for their machines. The answer is simple and straightforward. Todey's herdware manu-



facturer is little more than a technology packager. A manufacturer purchases a variety of subassemblies and semiconductor components and merely puts it all



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together in an attractive and functional package. Thus, corporations producing microcomputers are little more than pack-

aging and marketing operations. Software, which is generally more

sophisticated than its hardware counterpart, is not readily available as subassemblies or modules that can be configured to meet a particular requirement.

Software is complex technology even in its simplest form. No one would consider offering end users hardware that didn't function exactly as promised. On the other hand, there is a universal understanding that all software has "bugs." Furthermore. software is virtually impossible to debug comprehensively prior to its release. The independent software developer is able to compete with larger companies that might otherwise claim that their product is more thoroughly tested or better supported. However, most larger companies don't permit a programmar to maintain his connection with a particular product. Instead, they often assign bim to other projects, sometimes unrelated. Consequently, customer support can rarely rely directly on the developer.

In contrast, the independent software developer typically continues to work on

HERE IS a universal understanding that all software has "bugs."

bis product, offering an andless variety of enhancements, debugging strategies, and related products. He operates in an atmosphere devoid of bureaucratic budget constraints, company politics, unrealistic schedulas, and changes in corporate direction and amphasis.

Furthermore, he usually enters into a contract with his publisher that requires. among other things, that he be available to provide technical support, training, and occasionally sales support. He has the luxury of remaining actively involved with his product for years. And perhaps most important, he determines the features. functions, and banafits that his product or products will offer. He may not always be right in his decisions, but there is never any question as to who is in control of his product

He is also able to choose the market that he wishes to address and the marketing organization that will best present his product to that market. For example, vertical packages, which are becoming of increasing importance in the developing software market, are usually best marketed by an organization able to provide an outside sales force. Horizontal packages, such as word processors, are best marketed through dealers, bookstores, and telemarketing.

Furthermore, he is able to choose the broadest hardware base for his product and does not have to pin all his hopes on the marketing success of one hardware

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manufacturer or another. In fact, the broad base of CP/M-80 and MS-DOS users effectively allows him to target all micros if he wishes

wisnes. The advent of good C compilers for micros is a particularly important development for the independent software developer. They allow particular applications to be compiled on a wide variety of current hardware. Equally important, they allow particular applications to be compiled on future generations of machines.

This means that an author can expect a significantly greater lifetime for his products than heretofore possible. Previously, programmers writing in languages such as assembler were faced with the horrendous task of extensive recoding in order to transport their programs to new generation hardware. Their only alternative was to write their programs in languages such as BASIC or Poscal for which target machine compilers and cross compilers did not always exist.

Demand in Search of Supply

There exists an incredible demand for a wide diversity of software, but as yet no one has been able to determine a priori what constitutes a winning product.

The market for 16-bit applications packages if desperately searching for programs. Most of the 16-bit programs curvity available are little more than recast versions of 8-bit software. Unfortunately, many of the new features—the availability of screen graphics, large amounts of RAM. The 8097 arithmetic processor—offered by the BMY Cand its clones are not taken advantage of by the reincarnations.

THE MARKET for 16-bit applications packages is desperately searching for programs.

Also, many of the machines targeted for the home market have virtually little or no software of any consequence. The Timex TI 99/4 and Commodore 64, for example, are both excellent targets for low end software that can be easily provided by the independent software vendor.

The software market has many of the characteristics of a horse race. There are many entries, but few true winners. Yet

THE software market has many of the characteristics of a horse race.

the stakes are high, the entry fee relativelylow for the independent software downtoper, the opportunities for creativity and innovation virtually unlimited, the entirement unbridled ... It is an industry with infinite growth potential, unlikely to be dominated by the large corporations—all of which affords the entrepreneur with a unique opportunity. There is no more exciting field of technology and certainly none that is so easy to enter when one considere the potential for high external

sales we potential for fing results. Those who would fell you that he had been also self-through the last self-through through through through through through the last self-through through throu

Get into your basement, fire up your microcomputer, learn the Clanguage, astart writing that program you've been thinking about. Find yourself a publisher that you feel comfortable with, one who addresses the market that you are interested in, and you will be well on your way to the most exciting and rewarding adventure of your life! The time to start is now.

Eddie Currie is the president of Lifeboot Associotes, the world's largest software publisher. In the mid-1970s, he was Chief Executive Vice President of Micro Instrumentation and Telementary Systems (MITS), the New Mexico company that introduced the first consumer microcomputer, the Altair.



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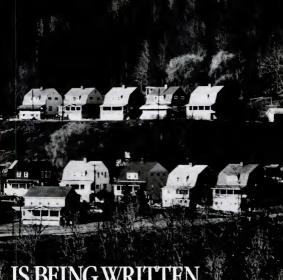
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According to Joyce Wren, Director of Software Publishing in Boca Raton, IBM is actively soliciting program proposals from its own employees and from anyone else with a good idea.

Start Spreading The News

On the waii of an executive office at IBM's Boca Raton, Florida complex hangs the needlepoint sampler that stars in a current television advertisement for the Personal Computer. It reads: "Hat of the Month Club."

Big Blue is not really entering the habendathery business, but it surely has tossed its chapseu with gusto into the consumer market for the first time with a line of in-house and independently developed software and books. In fact, it had already shipped 16 titles by the beginning of July, with more in the pipeline. These products are in addition to the commissioned or exquired programs in PC-DSO, Multideptition of the product of the products of the already cramming shelves in IBM-related stores.

"We know that when someone buys a PC, they're very likely to be back soon to the same place to pick up some software." said Joyce Wren, Director of Software Publishing for IBM's Entry Systems Division. That is why the company has entered into the market, she says, and that is at the heart of the sales pitch IBM gives to prospective authors.

"We can bring the expertise we have in areas of testing, publications, and experience in how a user uses software. I here to use the term 'user friendly,' but that is what we are talking about here," Wren said in on interview in Boca Ration recently. "We also have the manufacturing capability and distribution end marketing expertise."

And, in a roundshout way, Wern let It be known that she believes a software author can expect to earn more money if his or her work is encased in an IBM blonder. She would not divulge details but did indicate thet several individuals are near past the \$100,000 royality point in one or another of the various plans. (IBM, in the face of protests from outhors, recently removed a "Cap" on earnings that had been established at the level. There is



Joyce Wren, Director of Softwore Publishing for IBM's Entry Systems Division. in front of PC headquarters in Boca Roton.

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The Channels of Commerce

The software products are marketed through the same channels employed for the Personal Computer itself: IBM Product Centers and authorized dealers such as ComputerLand. Sears Business Systems Centers, and nonfranchised outlets.

IBM's official Softwore Submissions Guide states that the company "may establish other distribution channels in the future." Does this include non-IBM dealers? "Not today." Were said. "Wer looking at additional channels and a whole host of things relative to software, including faster distribution. We want our customers to be satisfied with the product. We want to be sure support can be offered."

"There is, though, the potential to offer entertainment software in a different manner," Wren said. How about mail order? "Probably not," she said.

An IBM Old Hand

Wen has worked for IBM for the past 22 years, starting as a programmer at Advanced Systems Development in San Jose, California. She wrote software in assembler, hexadecimal, macroassembler, and a number of higher-level languages, entering into the management structure in 1985. She came to Boca Ration in January of 1982, as the Software Submissions Program was first getting underway.

WE LOOK at our own employees as rich sources of submissions.

On her desk is a PC-XT flanked by a full load of pastel-shade IBM software binders. She has a PC at home, which she uses to continue her office work and for word processing and financial modeling. She admitted to spending a fair amount of time recently playing with IBM's as-yet unreleased LOCO language. That product is

scheduled for introduction in the last quarter of this year.

There are three sources of material for IBM's software program: external, internal, and employee submissions.

"We look at our own employees as a rich source of submissions." Wren said. One reason is the "substantial" number of PCs purchased by employees through IBM's discount program.

Internal contributions are those written by IBM employees on company time, either specifically for the consumer market or developed for other uses. A pair of recent—and successful—examples are Personol Editor and Professionol Editor. These products were developed at IBM's San Jose research site and were used extensively within the company before release. The product now on the stands is actually Version S. Wern said.

Internal company authors do not receive royalties, but are eligible for special awards not directly tied to sales.

Employee submissions are those made by IBM personnel on their own time and with their own resources. Product Centers and other authorized IBM dealers have recently begun selling the employee-originated Privote Tutor, a BASIC development system, as well as IBM's first book, an introduction to DOS 2.0.

Authors with no relation to IBM can sell a nonexclusive license with a negotiated royalty schedule based on wholesale revenues from sales. New products in this area include the BASIC Primer peckage. The external submissions run the whole gamut, from technical work to utilities to games.

IBM will continue to add to its store of software from a variety of sources, Wren said. In recent months, the company has add APL, an internal adaptation of an IBM-developed language, and the PeochText word processor, distributed under a license with Peachtree Software.

"We do so out and anoproach vendors

we do go out and approach vendors as well," Wren said, "although we did that more in the beginning. We wanted to be sure there was certain software for the PC when it was introduced."

Included in those first offerings were one or two products—an un-easy word processor among them—that will not be forever cherished by IBM or early users

forever cherished by IBM or early users.
"We found that people expect far more
from a product with the IBM logo," Wren
said, "even though the product when

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THE PC line will continue to be an open system.

Wren's department is the prime recipient of those user comment cards in the back of every piece of IBM software. There is a quality meeting every Monday at which measurable criteria on hardware and software are analyzed. According to Wren, many users' comments find their way into revisions or new products.

way into revisions or new products.

As with all other publishers and authors, Wren admitted to keeping a close watch on reviews of products. She likes to see both sides of any product described, not just the negative. "Don't expect us to be perfect. We try very hard for quality."

Openness Pays Off

Many observers say that one of the principal reasons behind the success of the PC has been IBM's choice of an "open" design-one that allows third-party software (and hardware) developers easy access. The company has published most of the details of its design in a series of technical reference manuals and has chosen to use as principal operating system a product that has been adopted by other manufacturers of hardware as a standard for machines built around the 8088 or 8086 microprocessor. This openness has led to the burgeoning market surrounding the PC (including PC Mogozine) and to the continued sales success of IBM's microcomputer.

"The PC line will continue to be an open system," Wren said. "It seems to me that the more good software available, the more applications there will be and the more sales."

A Copy-protection Quandary IBM and its authors are caught in the

same uncertainty faced by other software companies in regard to the coby-protection question. Some of the company's releases are unprotected, like the DOS and

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language packages, while others are protect locked against ordinary copying achemes. Many of iBM's applications and games makes applied a copying the packages employ a third alternative, which allows a single copy to be made for said. "I are actival purposes: IBM's introduction of a hard disk in its PC-XT and as an add-on to more the PC complicated matters since a copy-

protected program cannot be run from a hard disk.

"Many authors and software vendors still want to protect their work." Wren said. "But we may be moving toward unprotection. Obviously it gives the user more flexibility if a product is not protected."

The Guiding Byte: An IBM Sampler

Big Blue's guidelines for software authors should be required reading for anyone thinking of writing a new program.

The suggestions from IBM would probably serve as good advice for any would-be software author for the PC. Here are some samples:

Program code: Software should be structured in o "top-down" manner, with comments throughout. The remarks should be used to help in future maintenance and enhancement, referring to names of voriobies and their functions, diskette file formats, and references to internal ROM code.

Copyrights: Notices should appear in several pioces, including the first screen that appears, in memory whenever the program is running, within the first 20 lines when the program is printed, and on the external lobel of the diskette and pockaging.

Hardware dependency: The program should be oble to use both the monochrome display adapter and the color! gruphics odapter and be oble to check which adapter is installed in the PC being used. Device odopter (except for RS-232C control to the color of the color of the color of the in the program, crowling dependence on the particular version or revision of the hardware involved.

Follow IBM's rules: The program should not include Calls to internal ROM routines (undocumented entry points or entry points currently pointed to by internal rupi vectors.) I you do so, the program is dependent upon a particular release of DOS or 8ASK, or problem faced by o number of software developers when DOS 2.0 came alone in March.

Watch your colors: All monitors do not support all colors, and certain color codes are unusable when displayed on a monochrome monitor. Test your program on various combinations of monitors and disploy cards. Avoid unusual foreground/ background color combinations. One of the two colors should be black or white. Overuse of color will undermine its effect and could lead to confusion.

Same other hints: Allow for recovery from error; disploy messages during times when the computer is making calculotions or loading data; develop a consistent and orderly screen design; moke consistent use of the function keys and the Escape key; in games allow sound to be shut off if desired.

IBM even has its own lexicon of recommended words. A few samples: Do use end, cancel, or stop; don't use abort. Do use enter; don't use return. Do use correct, good, or true; don't use valid.

IBM EVEN has its own lexicon of recommended words.

And finally, IBM has a section on writing manuals, discussing such oftenignored elements as tone (conversational
recommended); voice (active: when you
operate the computer' is persted? it sense
when the computer is operated? it sense
ippresent), and language (clear and concises
and writh an avoidance of unnecessary intragon, abbreviations, acronyma, and
words.)

—C.S.



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The Guide to Submissions

Entrance to the Software Submissions Plan is a two-step process. Wren's program publishes a 40-page booklet—pack-aged in the same vinyl-clad folder used for many of the software products sold by IBM. Included in the folder is a copy of an agreement and questionnaire that must be forwarded to IBM. You'll have to discuss

competitive products, the characteristics of the program and documentation that make it "friendly and easy to install and operate," and the hardware and software requirements of the program.

Authors are strongly urged to register their work with the U.S. Copyright Office before submission. IBM warns that even

though the company will take proper precautions to maintain the integrity of your copyright, it has no obligation to treat submissions as secret or confidential.

The entire process from evaluation to



user-friendly database.

According to the Plan, criteria include the following:

• Are installation instructions easy to locate and follow? Do they require the

- locate and follow? Do they require the user to customize any hardware or software?

 Is the documentation complete, ac-
 - is the documentation complete, accurate, and easy to use and understand? Is it appropriate to the application and intended user?
 Does the product use sound, color,
 - and graphics effectively?

 Does the program provide adequate feedback to the user?
 - Do all of the functions in the program work? Are errors adequately prevented and detected?
 - How does the product compare to potentially competitive products already on the market? Do comparable products offer more or less in function and price?

And the final question for IBM to answer: Does this product seem a likely source of profit? Each of these points is discussed at length in a section of guidelines.

And the Winner Is . . .

Wren said the expects "productivity applications"—word processors electronic spreadsheets, and the like—to continue to be popular, "until use find additional uses for the computer." On the horizon, she said, may be a truly user-friendly database, with a natural language interface and a dynamic structure that would allow the program to adapt to the user rather than the other way around.

"The uses that we can put a personal computer to are endless," Wren said. And IBM, no doubt, will be peddling its hats, madly.

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Publishers that have traditionally looked to massmarket and trade books as the money makers, are, with the help of increasingly aggressive agents, crowding into the computer book and software markets.

The Softening of Publisher's Row

For years, two of the nation's leading trade conventions—the American Book Association (ABA) and the Consumer Electronics Show (CES), coexisted on the calendar without conflict.

Last June, however, when the ABA met in Dallas and the CES powwowed in Chicago, the shuttle express was working overtime, as numerous software manufacturers, distributors, and a new breed known as software agents crossed the country's midsection enough times to confuse their Windy City how-you-do's and their Lone Star state howdy's. Interestingly, these faces were neophytes on both show floors. But while the electronics moguls had already made space for microprocessors between their audios and videos, the booksellers still needed to be convinced. They were in the midst of a massive sales pitch from the software companies and ageots to convince them that the boom in computer book sales is but the first stage in the invasion of computerwares, which wants its share of shelf room between Jane Fonda and Garfield.

Twenty-three software publishers exhibited their goods at the ABA that month, while an avalanche of new computer titles pertaining to the various computers (even the unroasted Peanut) were spotted among the season's soon-to-be remaindered book iackets.

More than new faces and computertuated business cards were circulating on the ABA floor. Everyone was talking about the data. To those who had knocked about the land of gallen proces and attemption of the second of the data temporary was reminiscent of the 60s, when everyone seemed eager to read his way through the Nixon administration. The last 12 months had seen figures going to computer writes, both book and softfor more tilke Nixonan Muster and Judin Knutz. Cases in polit.

 Stewart Brand received \$1.3 million for an 8½-by-11 trade paperback (due Fall 1984) to be called the Whole Eorth Softwore Cotolog, patterned after the successful counter-cultural publishing venture of

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a similar name that Brand edited and published in 1968.

 Software publisher Bruce & James, creators of the Visionline computer programs, predict salas of up to \$100 million

K_{NOCKING} around in the San Francisco Bay Area inevitably leads to Silicon Valley, which helped supply a nation's craving for prunes and apricots years before it manufactured a single

after forging an exclusive U.S./Canada distribution deal with Simon & Schuster. Simon & Schuster launched the product line with the WordVision word processing program for the IBM PC, listed at a tempting \$49.95. (Bruce & James is the combined effort of Bruce McLoughlin and Iim Edlin.)

microchip.

- · Harper & Row has reportedly advanced \$600,000 to InfoWorld magazine for the rights to a forthcoming book series. The books will be machine-specific and will be taken largely from the publication's "Software Report Card" review serias. Meanwhile, Simon & Schuster, outbidding six other publishers, agreed to pay an \$800,000 guarantee for the PC World
- Reference Library. At press time, Kriva Systems, Inc. of Chicago, a software publisher noted for its Typing Tutor and Learning Lab educational titlas, was peddling the rights to a package of its products to prominent book publishers for a figure reported as high as \$20 million in royalties. Company presidant Sat Tara Khalsa explained (apparently with a straight face): "It's certainly a good place to start." Meanwhile, Ted Leonsis, publisher of the semi-occasional software guide LIST, was in the process of ironing out contractual glitches in a sixfigure, multi-book deal with Warner Software. New American Library (NAL)/Sig-

net was also about to add its name to the list of publishers that hed passed the million dollar mark with a computer-book-

related acquisition

News like this bas sent New York's publisher's row into a tizzy. Management is being shuffled to satisfy this new growth market. Simon & Schuster is predicting a \$5 billion-a-year bookware industry by 1985, Warner Books, E.P. Dutton, Simon & Schuster, MacMillan, Random House, NAL, and Herner & Row have all sactioned off special divisions devoted to computer book and software development. Pioneers in this field include Addison-Wesley, John Wiley, Prentice-Hall, McGraw-Hill, and Harcourt, Brace, Jova-

There are reports that B. Dalton is selling more computer books than fiction in its nationwide chain, and that computer books account for fully 10 percent of Dalton's business. Although this claim was attributed to a B. Dalton executive, and is commonly quoted as proof that computers have finally made their merk in bookstores, nobody there remembers saving it. "I suppose the quote is now generally

believed," explained B. Dalton division manager Tim Higgins, "There would be no point to stand up and scream and deny it. It was an overstatement though. I can't say that the business accounts for 10 percent of our total sales. I can state, though, that it is the fastest growing category."

Still, computer book seles were significant enough that 6 months ago, the comnany began to nublish a computer bestsellers list in its weekly in-house merchandise bulletin.

Software Agents

Agents end agencies haven't been left out of the ruckus. Sterling Lord, William Morris, even Morton Janklow, who gernered \$3.2 million for Judith Krantz's Princess Daisy, have let loose the leashes on prime agents with a taste for \$100,000 commission checks, Saab Turbos, and homes in the likes of Sag Harbor.

Though it would be an exaggeration to trace all this activity to one office-on the

What Kind of Software Are Publishers Looking For?

With all the sudden publicity about publisher acquisitions of software and computer books it might erroneously seem that this new outlet is a wide-open bonanza for the hacker population.

However, according to Jane Isay of Harper & Row, publishers are being more selective, and she offers some insight into what she and her peers are looking for.

'Immediately, the IBM PC fits into my publishing plans for everything but the games and educational software. I don't at the moment think that the PC is widely enough available in the home-for the kids-to make it worthwhile converting the educational and game software to the PC. But I'm watching it very closely. If they do come out with the Paanut, then it's going to be a different ballgame."

The software we are looking at has to be designed so that the computer is a tool of the user, and that the user is not some kind of slave, having to stick her nose in the documentation all the time to figure out what to do next. I require clarity of design, so that the command structure of any software I publish has a logic that doesn't require memorizing lots of things-that it's clear. I require a cartain quality of screen display; there's an aesthetic, or developing aesthetic, of screen display. In addition, I feel very strongly that the only software that Harper & Row should publish is software that does

things uniquely suitable for the computer. I get very irritable when I see software that is nothing but a workbook on the Does it pay to commission an agent to deal with the publishers? Isay replies that since the big doller publicity hes hit the

industry, numerous new and uneducated agents have been pitching computer-related deals. "I find myself irritated beyond words when an agent calls and says, '! have this thing. I don't understand it. But why don't you just give it a look.' I recently spoke to the Literary Agent Association and said that having an egent as the pocket of ignorance between the programmer and the publisher is harmful and crazy."

-M.P.

west side of Manhattan at that—it might at least be a good starting point to look at the Broadway address of John Brockman Associetes, a literary agancy that boasts a dual logo of winglike book leaves and tha magnetic Cyclops known as tha floppy disk.

John Brockman made all the aforementioned deals—landed some mighty big marlins, as the Hemingway literati might

MAKING deals for small independent software publishers is like going out for blue fish when the tuna are running.

put it. In just a few months, he accumulated close to \$3 million in advances for e handful of clients. The sum in itself is staggering, but it becomes even more so when you realize who, axactly, John Brockman is.

Brockman's reputation on the row is as a serious nonfiction agent for ruch esoistic clients as Allan Wart, soft half by Ground the clients as Allan Wart, soft half by Ground the result of the control of the row and lustful porno celebrity, Seka. His business apparently revolves around the Palo Alto Gretaley axis, which bloomed intellectually in the knocking around. Knocking around knocking around Knocking around Studies and the San Francisco Bay Area insvitably leads to Silicon Vallay, which halped supply a nation's craving for prunes and apricots years before it menufactured a single

"I had been building a vary successful business." Breckman recalled recently during a weak when ha was auctioning off yet another isk-figure computer book deal. (By the way, most of these auctions never make it to the slagar of a barmer since the Fortuna 500 companies prefer preempting the bids to avoid the secalatory back-and-figure of the sec

vary little software availabla."

Brockman never bought the computer, though hat is currently eyeing the BibM XT. He did change his company's logo, however, He had a realization: "First, there were going to be 25 million computer wowers by 1985. Each off them will havy between eight and ten computer books and \$1000 worth of softween. More inportant though, from my point of view, was low that everyone when buy as computer to a potential author of softween. More more not a potential author of softween. There was no such thing as a coftware ament."

no such toning as a software agent:
Like many agents who are now entering the computer business. Breckman at refresh taimed his effects at the mom and pop
software writers who had set up mail
order businesses in thair living rooms
with an occasional expansion downstaties
to the finished busement. He soon recognized bigger gams. Making daals for small
independent software publishers, at least
at this stage of the book 'computer connection, is like going out for blue fish whan

THE BOOK industry could be very receptive to an alternate source of income and revenue.

the tune are running.

Brockman earned his first commission or months later when he signed his first contract for client Bruce & James. Presistent Jim Edit negation Jim Edit negat

"It seemed to ma that bookstores have three areas of compatibility that make a lot of sense. The product is physically compatible with the kind of marchandise they handle. That is, we could make it be about the same size and shape and meke it look the same as the things they were already doing. It was conceptually compatible with what bookstores already did, anyway. In other words, it's not that far away from being e self-help book or reference book—that is, if it is priced right."

DOOK—that is, if it is priced right."
As an afterthought (though its significance shouldn't be slighted). Edilin added,
"Basidas, these days the book industry has
its problems. Therefore, it's an industry
that could be vary recaptive to an alternate
source of income and revenue."

You would think so, wouldn't you? But there was and still is resistance. Many of the industry's aristocrats appear uncomfortable with publishing electronics instead of the almighty written word. Even after the Association of American Publishers unenimously voted to eccept software makers into its ranks, bigh-lavel brass with leading imprints continued to snub their noses at the naw industry. Martin P. Levin, president of Times Mirror Books told a New York Times reporter, "I think it's a fad like hula hoops." Thomas McCormack of St. Martin's Press was quoted as adding, "There's bound to be an unpleasant shakeout." Still other book publishers have officially ignored the new trend, though thair marcanaries are scurrying around the country beating on microchip bushes as if they were Christmas trees.

Edlin and Brockman's seles job initially fall on deaf ears. They refined their pitch, gathered more ammunition, and even educated a publisher or two elong the way. Brockman explained what tipped

SUDDENLY, every writer who had ever touched a computer keyboard was pitching book deals.

tha balance: "I think the most important thing, from our point of view, was the Time magazine covar with the computer as 'Man of the Year.' The same week NBC ran a network speciel on the micro. And than there was tha overall gestalt of the thing; people ware realizing that this is not e fed, the tit's like the next industrial

PROGRAMMER'S GUIDE TO CP/M

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Lifers' an important collection of CP/M insights that you'll never find in any CP/M manual. CP/M is the most popular microcomputer DOS in use today, and this widespread use has generated many innovative techniques and enhancements of CP/M. Programmer's Guide to CP/M tells you what these

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revolution: Either you get into it or risk the consequences of running a railroad when everybody travels by plane."

Obviously the sales pitch worked. Simon & Schuster was receptive and also eager to move, since it promoted industry veteran Al Reuban to the presidency of a new division with computer books and

IF THE
market is as big as it
seems to be, then a
million dollars will be
nothing to let everybody
know that you're the
first person in it.

software under its wing. The company agreed that a product with a price point below \$50 could fit into the bookstore environment without requiring demonstration, selling, or hand-holding, Besides, software sales in bookstores was not an unknown quantity. B. Dalton had been experimenting with software sales in select bookstores (mostly around Washington D.C.) for several years, having mixed, though encouraging, results. On the other side, the book business had been eyeing the network of computer stores as possible outlets to augment their mass market distribution, which was already extensive.

If any one thing softened the acceptance of software in publishing circles, though, it was the fact that computer books were selling. The development was being called the most significant trend in the industry. Suddenly, every writer who bad ever touched a computer keyboard was pitching book deals. The media were bandying about an unattributed "fact" that computer buyers selected three (sometimes five, depending on who was quoting) book titles before making their computer format plunge. Meanwhile. companies like Addison-Wesley, which had been selling computer books for years. were suddenly making a fortune on properties that had only cost them \$10,000. The Ingram Book Company reported that

The Computer Press Association

A professional group formed to monitor the computer publishing business.

In response to the increasing market for words about computers—for documentation, magazine articles, and books—the Computer Press Association (CPA) was formed at last May's National Computer Convention (NCC) held in Anaheim, California.

According to its organizer Barbara Elman, a total of 500 writers to date have expressed interest in a professional group that will monitor the computer publishing business, give referrals, address writer legal Issues, and keep talso on publishers that don't pay their bills. Dues range from \$35 for an individual to \$100 for a corporation. Already, anthologies of writings by CPA members have been necessited with

major book houses.
For information contact: Barbara Elman at Word Processing News, 211 E. Olive, #210, Burbank. CA 91501. telephone: (213) 845-7809 or 854-4161.
—M.P.

its computer book sales rose from \$184,000 in 1981 to \$1.8 million in 1983. With the leverage of mass market heavyweights from the book business, it was believed the entire computerware market would skyrocket.

Million Dollar Books

Along with such predictions came the inflated prices. \$5.1 million was the price that did it. During each publishing year there is one Bigunt that remains set in every book person's mind. \$1.3 million identified 1933 since it was the price that Doubledsy paid to presempt a john Brockman suction of the U.S. Chand rights to a man suction of the U.S. Chand rights to a form the control of the U.S. Chand the Control of the U.S. Chand of the U.S. Chand between Brand's laid-back Whole Earth Cotolog best-seller, based on a 12-ness coulling.

Brockman commented. "I think Doubleday was after two things. First, they were making a statement that they were in the business. Second, I don't think they would have made such a statement unless they thought they could profit from the deal. I think they will show a profit very

easily. I think if we went to auction It would have gone for more money."

would have gone for more money."
Added Jay Acton, a principal in the
Software Agency, a computer merger of
the Sanford Corenburger and Moulter
agencies, "in many ways, on Doubledue,
announced to everybody that they were a
serious player in this thing. If the market is
a big as! I seems to be, then a million dollars will be nothing to let everybody know
that you're the first person in It.

Those are the words of agents who are doviously biased; they receive 15 percent of every penny they pitch successfully to the publisher. On the book side of things we have publishers are cringing, lane lasy, who was recently transferred from Harper & Row's Basic Books, to bead its new electronic publishing division related, "I think prices like these are going to destroy the market. If you look at the profitability of trade publishing and the number of mass market houses that have closed mass market houses that have closed

 $T_{ extit{HERE}}$

HERE is basically no difference between the obsessive tripping that goes on with drugs or with computers. They're both called users.

down in the last 5 years, you will see that the big bucks are a large cause of it.

"I think you will see each major publisher doing one of these deals, and then scurrying around madly to pick up the two-to-live-to-ten-to-twenty-thousand dollar books. He way they used to. A big figure does two things: It makes a statement and also commits a company to create the marketing to get the money back thus creating a market."

But Jane Isay and Harper & Row made a deal: They paid the \$600,000 guarantee to InfoWorld for rights to its forthcoming book series. The division's first software product, a \$100 word processing program for the Apple, is due in the stores this month. PROPERTY OF THE PROPERTY OF TH

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On the computer end of the business there was some question about the Stewart Brand deel as well, though the publicity brought micro celebrities to Brockman's doors with dollar signs in their eyes. Ted Leonsis, publisher of LIST, was drawn to the egent by the publicity (as well as Brockman's common request: "Ever

 $T_{\!\scriptscriptstyle HE}$

publishing guys are starting to feel there's a little life in the industry again for the first time in years.

thought of writing a book?, and es a result, eppears at press time to have signed e lucretive deel with Warner Software for e series of mechine format books that contain a mail order sampler of software.

ware.
"You can quote me on this, okay?"
Leonsis offered. "Who is Stewart Brend to
command \$1.3 million for software evaluations? Okay? One, streight software evaluations? Okay? One, streight software evalnent is not useful. Two, from e pure business standpoint they have to sell shout
baff a million books to break even."

Call the critiques of Brand end Brockmar is gold mine premature, microsnobber, or envy, the fact remains that the uncocompanies of the companies of the companies of the Cottolog, crested the independent publishing business and possibly the entire ofiny-roursel blook market, has set his sights on the computer. And, Brand is no nicroduced the pages on computers in his Next valves with a Kayper portable, included ten pages on computers in his Next Whole Earth Cottolog, and began investigating microprocessors with an article on 1972.

"Both the 60s and computers are ebout the same things," Brand explained. "The hackers, when I first wrote ebout them in 1972, were clearly all heads. Not ell heads, however, were hackers. Now, repidly, eil beads are becoming heckers. There is basicaily no difference between the obsessive tripping that goes on with drugs or with computers. They're both called users."

As with the Whole Earth Cotolog Brand end his research team, heeded by editor Art Kleiner, will begin with a series of periodicais, titled the Whole Eorth Software Review, which will be compiled in the book. Whole Forth Softwore Cotolog in Fell 1984. The 200-pege book will be produced by Brand's nonprofit Point Foundetion. The catalog will include input from software users, who will be encouraged to submit hands-on eveluetions of ell varieties of software and herdware for publication. In a sense, like its precursor that introduced everything from kerosene heaters to midwifery for the masses, the Whole Earth Softwore Catalog will be user-written as well as user-friendly. As part of the contract with Doubledev, there is only a 6-week turnaround scheduled between the day the publication boards

VITH
computers, something
new is happening every
second.

are delivered end the dey the book is in the stores. The eim wes to keep the catalog as up-to-date es possible, a Houdini-like tesk in an industry long dominated by quickchange artists.

"The book is going to change the publishing business In many ways. One is by sheking up the cartel of linertie thet has run the business for so long." Brend explained. "It usually takes 18 months to get a book out. There's no excuse for that. It is really punishing to the euthors end readers as well."

Research for the Whole Borth Softwore Catolog has already begun. The Point foundedton teem bes begun its solicitations of user groups throughout the country. The group Itself is armed with a work force of Keypros, though they are soliciting bardware grotis from evariety of menufacturers. IBM already turned them down. Brand admits the teem will be forced to purchase a PC, though he shows some lingering preference for the Compeq. The catalog, meanwhile, has grown from strictly software to hardware reviews es well, for "one-stop shopping," as Brand intoned.

intoned.

"The mejor thing I see heppening, though, is that the publishing guys are starting to feel there's a little life in the industry egain for the first time in years," he added. "The price we received might have frightened some people, but it seems to have cheered up everyone that publish-

ing is finally climbing back on its feet."

Others sgree the e state of enthusiasm
is raging down publisher's row. Jey Acton
reld, "It's like outfitting the world with
dictionaries all over again." However he
cautioned, "The book business better get
its ect together on this thing. The software
business has grown pretty far without the
publishers to this point."

The proof of the publishers' gambles won't be seen for 2 years yet. However, the sudden publicity an outsider like John Brockman has generated in treditional publishing circles hes left an impression het book people won't easily forget.

"Nobody puts e gun to e publisher's heed," Brockman said. "We don't say the price is so end so. We submit the meterial to e number of publishers, we create e market situetion, and they pay whet they want to pay, A book or software deal is worth only what somebody wants to pay for it."

LT'S like outfitting the world with dictionaries all

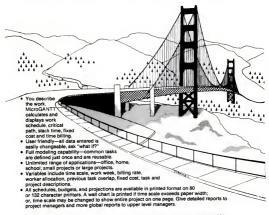
"Otherwise the publishing business is very moribund," he edded. "I see what's happening. I know whet's bappening. I know whet's bappening. And what's heppening is very little. With computers, something new is heppening every second. It's more of e challenge. You bewe to adjust. The microcomputer software business isn't just publishing—it's engular wild west show."

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The most important consideration when you choose a computer is "what programs will it run?" And that's one more reason for choosing the COMPAQ Portable. The COMPAQ Portable runs more programs

The COMPAQ Portable was designed to fit under a standand airline seat so you can take it on business tribs.



mnsam frame of the COMPAQ Portable has crossmembers that strengthen it front-toback, side-to-side, and top-to-bottom. It's a design practice commonly used in race cars.

than any other portable. In fact, it runs more than most non-portables. That's because it runs all the popular programs written for the IBM® Personal Computer. There are hundreds of them. They are available in computer stores all over the country, and they frum without any modification, right off run without any modification, right off

the shelf.

Imagine the power of a portable word processor. There are dozens of different word processing programs available for the COMPAQ Dortable.
Planning, problem-solving, and

"what-ifs" are a cinch with a variety of popular electronic spreadsheet programs. The COMPAQ Portable runs them all.

There are accounting programs for anything from computerizing your family budget to full-scale

professional management of payables, receivables, inventory, and payroll for your company.

There are programs for making charts and programs for communicating with

other computers. Or if you want something really specialized, there are even program languages for writing your own programs.

So, you get portability and you don't give up problem-solving power. The combination adds up to the most useful personal computer on the market today,

Works better because it's easy to read

The display screen of the COMPAQ Portable measures nine inches diagonally. It shows a full "page width" of 80 characters on a line so tasks like word processing are easier. And those characters are big enough to read even if you're leaning back in your chair.

The display shows both high-resolution caspitos and caspito-read, upper- and lowercase characters. One screen



I here are hundreds
of useful programs for the
COMPAQ Portable because it runs
all the popular programs written for the IBM.

for all the information. With some personal computers, including the IBM, you can have either the graphics or the legible characters, but you can't have both unless you buy two different displays.

Incidentally, computer prices are often quoted without a display. The display of the COMPAQ Portable is built in, of course.

Add-on options make it work the way you work

Inside the COMPAQ Portable are three open slots. Electronic devices called expansion boards fit those slots and give the COMPAQ Portable new powers. Just like the programs, expansion boards designed for the IBM work with the COMPAQ Portable, so there are dozens available right now. With them, you can make your personal computer

more personal.

Want to check a stock price? Or look up something in The New York Times Information Service? One expansion board enables the COMPAQ Portable to handle those communications over ordinary phone lines.

Want to use your company's central computer files while you're on a trip? There are boards that allow the COMPAQ Portable to communicate with a variety of large mainframe

computers.

Other boards let you hook up controllers for computer games or increase
memory capacity. Still others let you
connect personal computers in a network so several people in your office



Works better because it's tough enough for the road

Portable doesn't just mean smaller. Portable means tough, too.

The COMPAQ Portable was built to withstand the hard knocks of constant travel. An aluminum frame within the case completely surrounds the computer's working components. Each disk drive is mounted in rubber shock absorbers instead of being bolted directly to the frame.

To test internal components, the COMPAQ Portable was subjected to impacts of 40 G's while running a program. After impacts on each side, there was no internal damage and the program was still running. Without error. Computers are for getting rid of works.

ries, not giving you new ones. Designed to help you work better, too

The COMPAQ Portable was designed to feel good.

Specifications

Software

Runs all the popular program
written for the IBM PC

written for the IBM PC
Memory

128K bytes RAM
Expandable to 640K bytes

☐ One 320K-byte minifloppy disk drive, second drive optional

☐ 9-inch (diagonal) monochrome screen ☐ 25 lines by 80 characters

☐ Upper- and lowercase, highresolution text characters ☐ High-resolution graphics

Expansion board slots

Three IBM PC-compatible slots
Interfaces

☐ Parallel printer interface
☐ RGB color monitor interface
☐ Composite video monitor interface
☐ TV RF modulator interface
☐ Communications interface

optional

Physical specifications

□ Totally self-contained and portable
□ 20"W × 81/2"H × 16"D

The keyboard is detached so it can fit into your most comfortable working

position.

The keyboard cable remains connected at all times. So you don't have to unpack it and hook it up every time you use your computer.

Because the display is built in, the COMPAQ Portable makes a neat,

small package on your desk, instead of a big obstacle you have to talk around. The built-in display also avoids the usual cable clutter because there's no need

for separate cables for the display.

The COMPAQ Portable even has an electronically synthesized sound to create the familiar keyclick of a typewriter. With a simple keyboard command you can adjust the volume to suit the level of background noise in your office.

The added usefulness is free

The COMPAQ Portable can do what desktop computers do and do it in more places. But it doesn't cost any more than an ordinary desktop.

In fact, it costs hundreds less than a comparably equipped IBM or Apple*
III. The COMPAQ Portrable comes standard with one disk drive and 128K bytes of memory, both of which are usually extra-cost options. A second disk drive and additional memory are available to make your COMPAQ

Portable even more powerful.

The bottom line is this—you just can't buy a more practical, useful, productive computer. Before you decide on a computer, you owe it to yourself to compare the COMPAO Portable.

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THE MYTHICAL MAN-MONTH

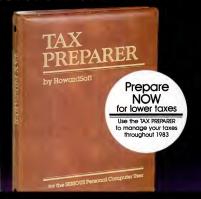
In 1964 Frederick Brooks become monoger of the team developing the operating system (OS) 360 Jose IBM's System 360. The mainframe computer that was the standard for the industry from the mid-1960s to the early-1970s—the longest reign of my system in the history of computing. Before he was put in charge of the OS' 360 software. Brooks had been project manager for the hardwoor orchitecture of the System's of the System's or the System's contractions of the System's contraction of the System's contractio

In the preface to his book. Brooks summed up three projects: "Monoging OS Saoks development was over educational experience, older to ever frustrating one. The teom, including F. M. Trappell who succeeded mean manager, has much to be proud of, the system contains many excellencies in design and execution, and it has been successful in ochieving widespread use... It is now quite reliable, reasonably efficient, and very versatile.

"The effort connot be colled whally successful, hawever. Any OS/360 user is quickly oware of how much better it should be. The flows in design and execution pervade



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aspecially the control program, os distinguished from the longuege compilars. Most of these flows dote from the 1964–1965 design period and hence must be loid to my chorge. Furthermore, the product was lote; it took more memory than planned; the costs were sevaral times the estimate; and it did not perform vary well until several releases often the first.

Before taking charge of the OS/360 project, Brooks had arranged to leave IBM to teach of the University of North Carolino beginning in 1965. In the following years, Brooks analyzed his experiences with development at IBM and wrote essays that ottampted to answer the question of why software development projects are so hard to manage.

Ten years ofter leaving IBM, Brooks compiled his conclusions on programming ond monogenent in a book—The Mythical Man-Month. In the decode since this book opposed, which has seen the emergence and rise of the microcompuler field, the hordwon lessons of common sense that Brooks provided have endured as pertinent advice for software developers as well on smonogers in ony industry.

Frederick Brooks is now Kenon Professor and choirmon of the computer sciences department of the University of North Corollno at Chopel Hill. He is preparing a mojor work on computer orchitecture in collaboration with Jerry Blou.

The Tar Pit

Een schip op het strond is een boken in zee.
[A ship on the beoch is o lighthouse to the seo.]

_DUTCH PROVERS

o scena from prehistory is quite so vivid as that of the mortal struggles of great beasts in the tar pits. In the mind's eye one sees dinosaurs, mammoths, and sabertoothed tigers struggiling against the grip of the tar. The flercar the struggle, the more antangling the tar, and no beest is so strong or so skillful but that ha ultimathy sinks.

Large-system programming has over the past decede been such e tar pit, and many great and powerful beasts have thrashad violently in it. Most have amargad with running systems-faw have met goals, schedules, and budgets, Large and small, massive or wire, team after team has become entangled in the tar. No one thing seems to cause the difficultyany particular paw can be pulled away. But the accumulation of simultaneous and interacting factors brings slower and slower motion. Everyone seems to heve been surprised by the stickiness of the problem. and it is hard to discern the neture of it. But we must try to understand it if we are to solve it.

Therefore let us begin by identifying the craft of system programming and the lovs and woas inherent in it.

The Programming Systems Product

One occasionally reads nawspaper ac-

counts of how two programmers in a remodeled garage heve built an importent program that surpasses the best efforts of



Sessoys on Softwore Engineering
Frederick P. Brooks, Jr.
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ISBN 0-201-00650-2
CIRCLE 78 ON READER SERVICE CARD

pared to believe such tales, for he knows that he could build any program much faster than the 1000 statements/year reported for industrial teams.

Why then have not all industrial programming teams been replaced by dedicated garage duos? One must look at whot is being produced.

In the upper left of Figure 1 is a progrom. It is complete in itself, ready to be run by the author on the system on which it was developed. That is the thing commonly produced in gareges, end that is the object the individual progremmer uses in astimatine productivity.

There are two ways a program can be converted into a more useful, but more costly, object. These two weys are represented by the boundaries in the diagram.

Moving down across the horizontal boundary, e progrem becomes a programming product. This is a program that can be run, tested, repeired, and extended by anybody. It is usable in many operating environments, for many sets of date. To become a generally useble programming product, a program must be written in a generalized fashion. In perticular the range and form of inputs must be generalized es much es the basic elgorithm will reasonably allow. Then the program must be thoroughly tested, so that it can be depended upon. This means that e substantial bank of test cases, exploring the input range and probing its boundaries, must be prepared, run, end recorded. Finally, promotion of e program to a programming product requires its thorough documentation, so that anyone may use it. fix it, end extend it. As e rule of thumb, I astimate that a programming product costs et least three times es much es a debugged program with the same function

Moving scross the vertical boundary, a program becomes a component in a programming system. This is a collection of programming system. This is a collection of function and disciplined in former, so that the assemblage constitutes an antire facility is for large tasks. To become a programming system component, a program must be written on that every input and output be written on that every input and output be written on the very input and output be written on the very input and output Federick P. Brooks, Fr. The Mythical Man-Month. C 1975, Addison-Mythical Reading, Mossochusetts. Reprinted with permission.



precisely defined interfaces. The program must also be designed so that it uses only a prescribed budgat of resources—memory spaca, input-output devices, computer time. Fically, the program must be tested

A S A RULE of thumb, I estimate that a programming product costs at least three times as much as a debugged program with the same function.

with other system components, in all expected combinations. This testing must be extensive, for the number of cases grows combinatorially, it is time-consuming, for subtle lugar arise from unexpected interactions of debugged components. A programming system component consumers are components as the component of the components of the c

In the lowar right-hand corner of Figure 1 stands the progromming systems product. This differs from the simple program in all of the above ways. It costs nice times as much. But it is the truly useful object, the intended product of most system programming efforts.

The Joys of the Craft

Why is programming fun? What delights may its practitionar expect as his reward?

First is the sheer joy of making things. As the child delights in his mud joe a Ast the child delights in his mud joe hithings of his own design. I think this delight must be an image of Cod's delight in must be an image of Cod's delight in must be hithings that are useful to othar people. Deep within, we want others to use our work and to find it helpful. In this respect work and to find it helpful to this respect when programming system is not essentially different from the child's first Caly pencil holder "for Dadd's' office."

Third is the fascioation of fashioning

complex puzzle-like objects of ioterlocking moving parts and watching them work in subtie cycles, pleying out the consequeoces of priociples built io from the beginning. The programmed computer has all the fascination of the pinball mechine or the jukebox mechanism, carried to the utimate.

Fourth is the joy of always learning, which springs from the nonrepeeting nature of the task. In one way or another the problem is ever oew, and its solver learns somathing: sometimes practical, sometimes theoretical, and sometimes

DOIN.
Finally, there is the delight of working in such a tractable medium. The programmer, like the poet, works only slightly removed from pure thought-stuff. He would be used to build shi scattles in the air, from air, creating by earticle of the imagination. Few madia of creation are so flexible, so easy to polish and rework, so resdiffy capable of realizing gand conceptual structures. (As we shall see later, this very tractability has its own problems.)

Yet the program construct, unlike the

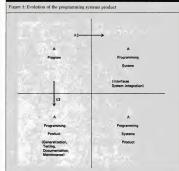
poet's words, is real in the sense that it moves and works, produciog visible outputs separate from the construct itsulf. It prints results, draws pictures, produces soudes, moves arms. The megic of myth and legood has come true in our time. One types the correct incantation on a keyboard, and a display screec ocomas to life, showing things that new a were nor could

Programming then is fun because it gratifies creative longings built deep withi, io us and delights sensibilities we have in scommon with all men.

The Woes of the Craft

Not all is delight, however, and knowiog the inherent woes mekes it assiar to bear them when they eppear.

First, one must perform perfectly. The computer resembles the magic of legend in this respect, too. If one charactar, one pause, of the incantation is not strictly in proper form, the magic dosan't work. Human beings are not occustomed to being perfect, and few areas of human activity demand it. Adjusting to the



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correspondence tont & s new body (tractor is optional), in addition to sill the leatures normally found on the old MX Series, which is being phased out. (The FX-100 is the 138 column version). The RX Series, which replaces the

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change. They dropped the pro-

portional tont, but kept the correspondence tont. The 120x144 dp, 5 tonts (witakes) 8 1K buffer ere standard. Gemini's comes with tractors & uses plain apool ribbons. The Gemini 19 is the 132 column version, & it has the correspondence font. Call for the latest & greatest in

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board. There's elso e lot of mis-information regarding peripheral boards& the IBM PC-XT. Fec. is, mo peripheral boards work on the XT out of the box—you don't need to up-grade the motherboard or elter it. Read your documentation carefully & watch out for "experts" in stores.

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requirement for perfection is, I think, the most difficult part of learning to program.¹

Next, other people set ona's objectives, provida ooe's resources, and furnish ooe's information. One rarely controls the circumstances of his work, or

THIS BOOK will attempt to lay some boardwalks across the tar.

even its goal. In management terms, one's eathority is not sufficient for his responsibility. It seems that in ell fields, however, the jobs where things get done never have formal euthority commensurate with responsibility. In practice, catual (as opposed to formal) authority is ecquired from the very momentum of eccomplishment.

The dependence upoo others has a particular case that is especially painful for the system programmer. He depends upon other people's programs. These ere often moldesigned, poorly implemented, incompletely delivered (no source code or test cases), and poorly documented. So he must spend hours studying and fixing things that io an ideal world would be complete, eveilable, and usable, and usable, and usable, and usable.

The next woe is that designing grand concepts is fun: floding nitty little bugs is just work. With any creative activity come dreary hours of tedious, painstaking labor, and programming is no exception.

Next, ooe fiods that dabugging has a linear convergence, or worse, where one somehow expects o quedratic sort of epproach to the end. So testing drags on and on, the lest difficult bugs taking more time to find than the first.

The last woe, and somatimes the last straw, is that the product over which one has labored so long appears to be obsolate upon (or before) completion. Already colleegues and competitors ere in hot pursuit of new and better ideas. Already the displecement of one's thought-child is not only concaived, but scheduled.

This elways seems worse then it really is. The new and better product is gaeerally not avoiloble when one completes his own; it is only talked about. It, too, will require months of development. The real tiger is naver a match for the paper ona, unless actual use is wanted. Then the virtues of reality have

a satisfection ell thair own.
Of course the technological base on
which one builds is alwoys advancing.
As soon es one freezas e design, it
becomes obsolete in terms of its concepts. But implamentation of reel prod-

ucts demands phasing and quentizing. The obsolascence of en implementation must be measured against other axisting implementations, not against unreelized concepts. The challeoge and the mission are to find real solutions to real problems on extuel schedules with available resources.

This then is programming, both a tar pit in which many efforts have floundered and e creetive ectivity with joys and woes all its own. For many, the joys far outweigh the woes, and for them the remeinder of this book will attempt to lay some boardwelks ecross the tar.



The Mythical Man-Month

Good cooking takes time. If you are made to wait, it is to serve you better, and to please you.

-MENU OF RESTAURANT ANTOINE, NEW ORLEANS

ore software projects have gone awry for lack of catendar tima than for all other causes combined. Why is this cause of disaster so common?

First, our techniques of estimating are poorly developed. More seriously, they

reflect an unvoiced assumption which is quite untrue, i.a., that all will go well. Second, our estimating techniques fallaciously confuse effort with progress, hiding the assumption that men end

months are interchangeable.

Third, because we are uncertain of our

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8384 Hercules Street, La Mesa, California 92041 Nationwide (800) 854-2750 • In CA (800) 552-8817 Local (619) 460-4975 Figure 2: Time versus number of workers perfectly partitionable task Figure 3: Time versus number of workersunpartitionable tosk Figure 4: Time versus number of workersportitionoble tosk requiring communication Figure 5: Time versus number of workerstosk with camplex interrelationships

estimates, software manegers often lack the courteous stubbornness of Antoine's chef.

Fourth, schedule progress is poorly monitored. Techniques proven and routine in other engineering disciplines are considered redical innovations in software engineering.

Fifth, when schedule slippaga is recognized, the natural (and traditional) response is to add manpower. Like dousing a fire with gasoline, this makes matters worse, much worse. More fire requires more gasoline, and thus begins a regenerative cycle which ends in disaster.

Schedule monitoring will be the subject of a separate essay. Let us consider other aspects of the problem in more detail.

Optimism

All programmers are optimists. Perspet his modern sorrey specially attracts those who believe in happy endings and fairy godnothers. Perhaps the hundreds of nitty frustrations office wavey all to those who bolistically focus on the end goal. Perhaps it is merely that computers eavy young, programmers are younger, and the young are always optimists. But however, the programmer of the programmer of the young are always optimists. But however, the programmer of the programmer of the programmer of the young are always optimists. But however, the programmer of the programmer of the young are always optimists. But however, the programmer of the young are always optimists, but how they will be programmer of the programmer of the young they have young

So the first false assumption thet underlies the scheduling of systems programming is that oil will go well, i.e., that each tosk will toke only os long os it "ought" to toke.

HE incompletenesses and inconsistencies of our ideas become clear only during implementation.

The pervasiveness of optimism among programmers desaryes more than a flip analysis. Dorothy Sayers, in her excellent book. The Mind of the Moker, divides cretive activity into three stages: the idea, the implementation, and the interaction. A book, then, or a computer, or a program comes into axistence first as an ideal comes.

struct, built outside time end space, but complete in the mind of the euthor. It is realized in time and space, by pen, ink, and paper, or by wire, silicon, and ferrite. The creation is complete when someone reads the book, uses the computer, or runs the program, thereby interacting with the mind of the maker.

This description, which Miss Sayers uses to illuminate not only human creative activity but elso the Christian doctrine of the Trinty, will help us in our present task. For the human makers of hings, the incompletenesses and inconsistancies of our ideas become cleer only outrigs, incompletenesses and inconsistancies of our ideas become cleer only outrigs outriged in the completenesses and inconsistancies of the complete of the

In many creative ectivities the medium of execution is introctable. Lumber splits; paints smear; electrical circuits ring. These physical limitations of the medium constrain the ideas that may be expressed, and they elso create unexpected difficulties in the implementation.

Implementation, then, tekes time and sweat both because of the physical media and because of the inadequacies of the underlying ideas. We tend to hlame the physical media for most of our implementation difficulties; for the media are not "ours" in the wey the ideas are, and our pride colors our judgment.

Computer programming, however, crestes with an exceedingly tractable medium. The programmer builds from pure thought-stuff concepts and very flexible representations thereof. Because the medium is tractable, we expect few difficulties in implementation; hence our pervasive optimism. Because our ideas are faulty, we have bugs; hence our optimism is unjustified.

In a single task, the essumption that all will go well hes probabilistic effect on the schedule. It might indeed go as planned, for there is probability distribution for the delay that will be encountered, and "no delay" has a finite probability. A large programming effort, however, consists of many tasks, some chained end-to-end. The probability that each will go well becomes vanishingly small.

The Man-Month

The second fallacious thought mode is expressed in the very unit of effort used in estimating and scheduling the man-



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month. Cost does indeed vary as the product of the number of men and the number of months. Progress does not. Hence the mon-month as a unit for measuring the size of a job is a dangerous and deceptive myth. It implies that men and months are interchangeable.

Men and months are interchangeable commodities only when a task can be partitioned among many workers with no communication omong them (Figure 2). This is true of reaping wheat or picking cotton; it is not even opproximetely true of systems programming.

When e task cannot be partitioned because of sequential constreints, the application of more effort has no effect on the schedule [Figure 3]. The beering of a child takes nine months, no metter how many women ere assigned. Meny software tasks have this characteristic because of the sequential nature of debugging.

In tasks that can be partitioned but which require communication emong the subtesks, the effort of communication must be added to the amount of work to be done. Therefore the best that can be done is somewhat poorer than en even trade of men for months (Figure 4).

The added burden of communication is made up of two parts, training end inter-communication. Each worker must be trained in the technology, the goals of the effort, the overall strategy, end the plan of work. This training cannot be partitioned, so this part of the added effort varies linearly with the number of workers.²

Intercommunication is worse. If each peri of the test must be separately coordinated with each other part, the fort increase as infa-1)2. Three workers require three times as much four require six times as much as the contemporary of the contemporary three need to be conferences among three, four, etc., workers to resolve things jointly, metters get worse may fully countered the division of the contemporary of the situation of Figure 3.

Since software construction is inherently e systems effort—an exercise in complex interreletionships—communication effort is great, and it quickly dominates the decreese in individual task time brought about by partitioning. Adding more men then lengthens, not shortens, the schedule. Oversimplifying outrageously, we stete Brooks's Law:

Adding manpower to a late software project makes it later.

This then is the demythologizing of the man-month. The number of months of e project depends upon its sequential constraints. The maximum number of men depends upon the number of independent subtasks. From these two quantities one can derive schedules using fewer men and more months. (The only risk is product obsolescence.) One cannot, however, get workable schedules using more men and fewer months. More software projects have gone awry for lack of calendar time than for all other causes combined

Passing the Word

He'll sit here and he'll soy, "Do this! Do thot!" And nothing will happen.

—HARRY S. TRUMAN, ON PRESIDENTIAL POWER³

Assuming that be has the dislicaplined, experienced archiveplined and that there are many implementers, how shall the meneger ensure that everyone bears, understands, and implements the erchitects' decisions? How can a group of 10 architects maintain the conceptual integrity of a system which 1000 men are building? A whole technology for doing this was worsted out for the System/360 bardware design effort, and if is equally applicable to software projects.

Written Specifications—the Manual

The manual, or written specification, is a necessary tool, though not a sufficient one. The manual is the external specification of the product. It describes and prescribes every detail of what the user sees.

As such, it is the chief product of the specification.

Round and round goes its preparation cycle, es feedback from users and implementers shows where the design is ewkward to use or build. For the sake of implementers it is importent that the changes be quantized—that there be dated versions eppearing on a schedule.

The manual must not only describe verything the user does see, including all interfoces; it must also refrein from describing what the user does not see.

That is the implementer's business, and there his design freedom must be unconstrained. The architect must elweys be unconprepared to show on implementation for any feature he describes, but he must not extempt to dictate the implementation.

The style must be precise, full, and accurately deteiled. A user will often refer to a single definition, so each one must repeat all the essentials and yet all must

egree. This tends to make menuals dull reading, but precision is more important than liveliness.

The unity of System/380's Principles of Operation springs from the fact that only two pens wrote it: Gerry Blaauw's and Andris Padegs.' The ideas are those of about ten men, but the casting of those decisions into prose specifications must be done by only one or two, if the consistency of prose and product is to be maintained. For the writing of definition will necessitate a host of mint-decisions which

usined. For the writing of e-definition will increase the necessitate a host of mini-decisions which are not of full-debate importance. An example in System/360 is the detail of how the Condition Code is set after each operation. Not trivial, however, is the principle that such mini-decisions be made consistently throughout.

I think the finest piece of manual writing however seen is Planuary Amendia.

ing I have ever seen is Blaauw's Appendix to System/360 Principles of Operation. This describes with care and precision the limits of System/360 compatibility. It defines compatibility, prescribes what is to be achieved, and enumerates those areas of external appearance where the architecture is intentionally silent and where results from one model may differ from those of another, where one copy of a given model may differ from another copy, or where a copy may differ even from itself efter an engineering change. This is the level of precision to which manual writers aspire, end they must define what is not prescribed as carefully as what is.

Formal Definitions

English, or any other buman language, is not naturally a precision instrument for such definitions. Therefore the manual writer must strain himself end his lan-

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guege to echieve the precision needed. An ettractive alternative is to use e formal notation for such definitions. After all, precision is the stock in trade, the raison d'être of formal notations.

Let us examine the merits end weaknesses of formel definitions. As noted, formal definitions are precise. They tend to be complete: geps show more conspicuously, so they ere filled sooner. What they lack is comprehensibility. With English prose one can show structural principles. delineate structure in steges or levels, end give examples. One can readily mark exceptions and emphasize contrasts. Most important, one can explain why. The formal definitions put forward so far have inspired wonder at their elegance and confidence in their precision. But they have demanded prose explanations to make their content easy to learn and teach. For these reasons, I think we will see future specifications to consist of both a formal definition ond a prose definition.

An ancient adage warns, "Never go to sea with two chronometers; take one or three." The same thing clearly applies to prose and formal definitions. If one has both, one must be the stendard, and the other must be a derivetive description, clearly lebeled as such. Either can be the primary standerd. Aigol 68 has a formal definition as standerd and e prose definition as descriptive. PL/I has the prose as standard end the formal description as derivetive. System/360 also has prose as standard with e derived formel descrip10,000 gallon/day capacity before being used for a 2,000,000 gall on/dey community weter system.

Progremming system builders have also been exposed to this lesson, but It seems to have not yet been learned. Project after project designs a set of algo-

HE BEST planning is not so omniscient as to get it right the first time.

rithms and then plunges into construction of customer-deliverable software on a schedule that demands delivery of the first thing built.

In most projects, the first system built is barely usable, it mey be too slow, too big, awkward to use, or all three. There is no alternative but to start egain, smarting but smarter, and build a redesigned version in which these problems are solved. The discard and redesign may be done in one lump, or it may be done piece-byplece. But all large-system experience shows that it will be done. Where a new system concept or new technology is used, one has to build a system to throw away, for even the best planning is not so omniscient es to get it right the first

The management question, therefore, is not whether to build a pilot system end throw it eway. You will do that. The only question is whether to plan in advance to build e throwewey, or to promise to deliver the throwaway to customers. Seen this wey, the answer is much clearer. Delivering that throwewey to customers buys time, but it does so only et the cost of agony for the user, distraction for the builders while they do the redesign, and e bed reputation for the product that the best redesign will find hard to live down.

Hence plan to throw one owoy; you will, on vhow.

The Only Constancy Is Change Once one recognizes that a pilot system

must be built and discarded, and that a



Plan to Throw One Away

There is nothing in this world constant but inconstancy.

It is common sense to take a method and try it. If it fails, admit it frankly and try onother. But obove oil, try something.

-FRANKLIN D. ROOSEVELT4

-SWIFT

Pilot Plants and Scaling Up Chemical engineers learned long ego

that a process that works in the laboratory cannot be implemented in e fectory in only one step. An intermediate step called the pilot plont is necessary to give experience in scaling quantities up end in operating in nonprotective environments. For example, a laboratory process for desalting weter will be tested in a pilot plant of

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redesion with changed ideas is inevitable. it becomes useful to face the whole phenomenon of chenge. The first step is to accept the fact of change as a way of life. rather then en untowerd and annoying exception. Cosgrove has perceptively pointed out that the programmer delivers satisfection of a user need rather then env tangible product. And both the actual oeed and the user's perception of thet need will change as programs ere built. tested, and used.6

Of course this is also true of the needs met by hardwere products. whether new cars or new computers. But the very existence of a tangible object serves to contain and quentize user demend for changes. Both the trectebility end the invisibility of the software product expose its builders to perpetual chenges in requirements.

Far be it from me to suggest that ell changes in customer objectives end requirements must, cen, or should be incorporated in the design. Clearly a threshold has to be esteblished, end it must get higher and higher es development proceeds, or no product ever eppeers.

Nevertheless, some changes in objectives are ineviteble, and it is better to be prepared for them then to essume thet they won't come. Not only ere changes in objective inevitable, changes in deveiopment stretegy end technique ere elso ineviteble. The throw-one-away concept is itself just an ecceptance of the fect that es one learns, he chenges the design.7

throw-one-away concept is itself just an acceptance of the fact that as one learns, he changes the design.

Plan the System for Change

The ways of designing e system for such change ere well known and widely discussed in the literature-perhaps more

widely discussed than practiced. They include careful modularization, extensive subroutioing, precise end complete definition of intermodule interfeces, and complete documentation of these. Less obviously one wants standard calling sequences and teble-driven techniques used wherever possible.

Most important Is the use of a highlevel language and self-documenting techniques so as to reduce errors induced by chenges. Using compile-time operations to incorporate standerd declarations helps

powerfully in meking changes. Quentization of chenge is an essential technique. Every product should heve

oumbered versions, end each version must heve its own schedule end e freeze dete, efter which changes go into the next version.

Two Steps Forward and One Step Back

A program doesn't stop changing when it is delivered for customer use. The changes after delivery are called program mointenance, but the process is fundamentally different from hardware maintenance.

Hardware maintenance for a computer system iovolves three ectivities-replacing deteriorated components, cleaning and lubricating, and putting in engineering changes that fix design defects. (Most, but not all, engioeering changes fix defects in the realization or implementation, rather than the architecture, end so ere invisible to the the user.)

Progrem meintenence involves no cleaning, lubrication, or repair of deterioratioo, it consists chiefly of chenges that repair design defects. Much more ofteo than with hardware, these chenges in-

Figure 6: Bue occurrence as a function of release age



clude added functions. Usuelly they are visible to the user.

The total cost of mainteioing a widely used program is typically 40 percent or more of the cost of developing it. Surprisingly, this cost is stroogly affected by the oumber of users. More users find more bugs.

ID BUGS found and solved in previous releases tend to reappear in a new release.

Betty Campbell, of MIT's Laboratory of Nuclear Science, points out an interesting cycle io the life of a particular release of a program, it is shown to Figure 6. Initially. old bugs found and solved to previous releases tend to reeppear in e new release. New functions of the new release turn out to have defects. These things get shakeo out, and all goes well for several mooths. Then the bug rate begins to climb again. Miss Campbell believes this is due to the arrival fo users at a new plateau of sophistication, where they begin to exercise fully the new capabilities of the release. This intense workout then smokes out the more subtle bugs in the new features."

The fundamental problem with progrem meintenence is that fixing e defect has a substantial (20-50 percent) chance of introducing another. So the whole process is two steps forward and one step back.

Why aren't defects fixed more cleanly? First, even a subtle defect shows itself es a local failure of some kind, to fact it often has system-wide ramifications, usually oooobvious. Any ettempt to fix it with minimum effort will repair the local and the obvious, but unless the structure is pure or the documentation very fine, the far-reaching effects of the repair will be overlooked. Second, the repeirer is usually not the man who wrote the code, and often he is a junior programmer or train-

As a consequence of the introduction of new bugs, program maintenance requires far more system testing per statement written than any other programming. Theoretically, after each fix one must run the entire bank of test cases previously run against the system, to ensure that it bas not been damaged in an obscure way. In practice such regression testing must indeed approximate this theoretical ideal, and it is very costly.

Clearly, methods of designing programs so as to eliminate or of least illuminate side effects can have an immense payoff in maintenance costs. So can methods of implementing designs with fewer people, fewer interfaces, and hence fewer

One Step Forward and One Step Back

Lehman and Belady have studied the history of successive releases in a large operating system. They find that the total number of modules increeses linearly with release number, but that the number of modules affected increases exponentially with release number. All repairs tend to destroy the structure, to increase the entropy and disorder of the system. Less and less effort is spent on fixing original design flaws; more and more is spent on fixing flaws introduced by earlier fixes. As time passes, the system becomes less and less well-ordered. Sooner or later the fixing ceases to gain any ground. Each forward step is matched by a backward one. Although in principle usable forever, the system has worn out as a base for progress. Furthermore, machines change, configurations change, and user requirements change, so the system is not in fact usable forever. A brand-new, from-the-groundup redesign is necessary.

And so from a statistical mechanical model, Belady and Lehman arrive for programming-systems at a more general conclusion supported by the experience of all the earth. "Thinga are always at their best in the beginning." said Pascal. C.S. Lewis bas stated it more perceptively:

That is the key to history. Terrifice nearly is expended—civilizationed—civilizationed built up—excellent institutions devised: but each time something serving. Some fotal flow olways brings the selfish and cruel people to the top, and then it all sides back into misery and ruin. In fact, the machine coals: It seems to start up all right and runs a few yords, and then it break down. "It systems program building is an entro-

py-decreasing process, bence inherently metastable. Program meintenance is an entropy-increasing process, and even its

most skillful execution only delays the subsidence of the system into unfixable obsolescence.

The Whole and the Parts

I con call spirits from the vosty deep. Why so con I, or so can ony man; but will they come when you do coll for them?

-SHAKESPEARE, KING HENRY IV, PART I

The modern magic, like the old, has its boastful practitioners: "I can write progrems that control air traffic, intercept ballistic missiles, reconcile bank accounts, control production lines." To which the answer comes, "So can I, and so cen any man, but do they work when you do write them?"

How does one build a program to work? How does one test a program? And bow does one integrate a tested set of component programs into a tested and dependable system? We have touched upon the techniques here and there; let us now consider them somewhat more systematically.

Designing the Bugs Out Bug-proofing the definition. The most per-

nicious and subtle bugs are system bugs arising from mismatched assumptions made by the euthors of various components. In short, conceptual integrity of the product not only makes it easier to use, it also makes it easier to build and less subject to bugs. So does the detailed, painstaking

architectural effort implied by that approach. A. Vyssotsky, of bell Telephone Laboratories' Safeguard Project, asys, "The crucial task is to get the product defined. Many, many failures concern exactly those aspects that were never quite specified." Unreful function definition, carrful specification, and the disciplined exortism of frilis of function and flights of technique all reduce the number of system bugs that have to be found.

Testing the specification. Long before any code exists, the specification must be handed to an outside testing group to be scrutinized for completeness and clarity. As Vyssotsky says, the developers themselves cannot do this: "They won't tell you they don't understand fit they will happily invent their way through the gaps and obscurities."

Too-down design. In a very clear 1971

paper, Niklaus Wirth formalized a design procedure which had been used for years by the best programmens. If Purthermore, bis notions, although stated for program design apply completely to the design of complex systems of programs. The division of system building into architecture, implementation, and realization is a membodiment of these notions; furthermore, each of the architecture, implementation, and realization architecture, implementation, and realization is an expectation, and realization can be best done by

top-down methods. Briefly, Wirth's procedure is to identify design as a sequence of refinement steps. One sketches a rough task definition and a rough solution method that achieves the principal result. Then one exemines the definition more closely to see how the result differs from what is wanted, and one takes the large steps of the solution and breaks them down into smaller steps. Each refinement in the definition of the task becomes a refinement in the algorithm for solution, and each may be accompanied by a refinement in the date representation. From this process one identifies mod-

ules of solution or of date whose further refinement can proceed independently of other work. The degree of this modularity determines the adaptability and change-determines the adaptability and change-determines the adaptability and change-delimines the solution as its possision. With devocates as its possision and concealing the details until further refinement becomes necessary.

A good top-down design avoids bugs in

several weys. First, the clarity of structure and representation makes he precise statement of requirements and functions of the modules easier. Second, the partitioning and independence of modules avoids system bugs. Third, the suppresion of deteil makes flaws in the structure more apparent. Fourth, the design can be tested at each of its refinement steps, so testing can start earlier and focus on the proper level of detail at each step.

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The process of step-wise refinement does not mean that one never has to go back, scrap the top level, and start the whole thing egain as he encounters some

AM
persuaded that topdown design is the most
important new
programming
formalization of the
decade.

unexpectedly knotty detail. Indeed, that happens often. But it is much easier to see exactly when and why one should throw away a gross design and start over. Many poor systems come from an attampt to salvage a bad basic design and patch it with all kinds of cosmatic reliaf. Top-down design reduces the temptation.

I am persuaded that top-down design is the most important new programming formalization of the decade.

Structured programming. Another important set of new ideas for designing the bugs out of programs derives largely from Dijkstra, ¹³ and is built on a theoretical structure by Böhm end Jacopini. ¹⁴

unit by a count was parcel to design proparation by the proposal to the city of parpearation by the city of the city of the part of the city and the city of the part of the city of t

The basic notion is surely sound. Many criticisms have been made, and additional control structures, such as en n-way branch (the so-called CASE statement) for distinguishing among many contingencies, and a disaster ball-out (GO TO ABNORMAI, END) are very convenient. Purther, some have become very doctrinaire about avoiding ell GO TO's, and that seems excessive.

The important point, and the one vital to constructing bug-free programs, is that one wants to think about the control structures of a system as control structures, not as individual branch statements. This way of thinking is a major stee forward.

Component Debugging

The procedures for debugging programs have been through a great cycle in the past twenty years, and in some ways they are back whare thay startad. Tha cycle has gone through four steps, and it is fun to trace them and see the motivation

for each.

On-machine debugging, Early machines bad relatively poor input-output dealty.

Beautively poor input-output dealty, beautively poor input-output dealty, beautively poor, beautively dealty, beautively poor, beautively beautively dealty, beautively beautively dealty dealty dealty dealty dealty dealty dealty dealty dealty and the proposed printing. This made tape input-output intolarably awkward for debugging, so the console was used instead. Thus debugging was designed to allow as meny triels as possible por machine assistant.

The programmer carefully designed his dabugging procedure—planning where to stop, what memory locations to examine, what to find there, and what to did he didn't. This maticulous programming of himself as a dabugging machine might well take hell as iong as writing the computer program to be dabugged.

The cardinal sin was to push START boldly without having segmented the program into test sections with planned stops.

Memory dumps. On-mechine debugging was very effective. In a two-hour session, one could gat perhaps a dozen shots. But computers were very scarce, and vary costly, and the thought of all that machine time going to waste was horrifying.

So when bigh-speed printers were statched on-line, the technique changed. One run a program until a check failed, and then dumped the whole memory. Them began the laboritous disk work. Then began the laboritous disk work. Constitute The delicit time was not much different than that for on-machine debugging, but it occurred after that test run, in deciphering, rather than before, in planning, Debugging for eny particular user took much longer, because test shots depanded upon both turnaround time. The whole procedure, however, was designed to minimize computer time use.

and to serve as many programmers as possible.

Snopshots. The machines on which memory dumping was developed had 2000-4000 words, or 8K to 16K bytes of memory. But memory sizes grew by leans and bounds, and total memory dumping became impractical. So people developed techniques for selective dumping, selective tracing, and for inserting snapsbots into programs. The OS/360 TESTRAN is an end-of-the-line in this direction, allow-Ing one to insert snapshots into a program without reassembly or recompilation Interoctive debugging. In 1959 Codd and his coworkers15 and Strachev16 eech reported work aimed at time-shared debugging, a way of echieving both the instant turnaround of on-mechine dabugging and the efficient machine use of batch debugging. The computer would have multiple programs in memory, ready for execution. A terminal controlled only by program, would be associated with each progrem being debugged. Debugging would be under control of a supervisory program. When the programmer at a tarminal stopped his program to examine progress or to make changes, the supervisor would run another program, thus keeping the machines busy.

THE
cardinal sin was to push
START boldly without
having segmented the
program into test
sections with planned
stops.

Codd's multiprogramming system was developed, but the emphasis was on throughput enhancement by sflictent input-output utilization and interactive debugging was not implemented. Strachey's ideas were improved and implamented in 1963 in ea experimental system for the 7990 by Corbatio and colleagues et MIT.'TIS. This development led to the MULTICS, TSS, and other timesharing systems of today. Expanding Your PC or XT?

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The chief user-perceived differences between on-machine debugging at first practiced and the interactive debugging of todey are the fecilities made possible the presence of the supervisory program and its associeted language interpreters. One can program and debug in a highlevel lenguage. Efficient editing fecilities make changes and snepshots aseys.

COMMON sense, if not common practice, dictates that one should begin system debugging only after the

vieces seem to work.

Return to the instant-turnaround capability of on-machine debugging has not yet brought a return to the preplanning of debugging sessions. in e sense such preplanning is not so necessary as before, since machine tima doesn't waste ewey while one eits and thinks.

Nevartheless, Gold's interesting experimental results show that three times es much progress in interactive debugging is much progress in interactive debugging is stoned in the first interaction of each session as on subsequent interactions. ¹⁸ This strongly suggests that we are not realizing the potential of interaction due to leck of session planning. The time has come to dust off the old on-machine techniques.

I find that proper use of a good terminal system requires two hours at the desk for each two-bour session on the terminal. Half of this time is spent in sweeping up after the last session: updeting my debugging log, filing updeted program listings in my system notebook, explaining strange pbenomene. The other balf is spant in preperetion: plenning changes end improvements and designing detailed test for next time. Without such planning, it is hard to stey productive for as much as two bours. Without the post-session sweepup, it is hard to keep the succession of terminal sessions systemetic end forwardmoving.

Test coses. As for the design of actuel dabugging procedures and test cases, Gruenberger has an aspecially good treament, 19 end there are shorter treetments in other standard tests. 20,21

System Debugging

This unexpectedly hard part of building programming system is system itsel. have already discussed some of the resons for both the difficulty end its unexpectedness. From all of thet, one should be convinced of two things System debugging will take longer than one expect, and stifficulty unities a thoroughly systematic and plenned opprorech. Let us now use what such an experced involves. I will be such as the contract of the c

Common practice departs from this in two ways. First is the bold-14-cognther-endtry epproach. This seems to be based on the notion that there will be system (i.e., intarface) bugs in addition to the component bugs. The sooner one puts this pieces together, the sconer che gystem bugs will emerge. Somewhat less cophisticated is tha notion that by using the pieces to test each other, one words a but of test scaffolding. Both of these are obviously trus. Whola truth—the use of clean, debugged components saves much more time in system testing then thet spent on scoffoliars that the story of the story of the story the story that the story of the story that the story of the story the story the story that the story the story that the story of the story the story that the story of the story the story that the story the story the

only after the pieces seem to work.

A little more subtle is the "documented bug" approach. This seys that e component is ready to enter system test when all the flews ere found, well before the time when ell are fixed. Then in system testing, so the therory goes, one knows the expected effects of these bugs and can ignore those effects, concentrating on the naw whenomena.

and thorough component test.

All this is just wishful thinking, invented to retionalize every the poin silipped schedules. One does not know all the expected effects of known bugs. If things were straightforward, system testing wouldn't be hard. Furthermore, the fixing of the documented component bugs will surely inject unknown bugs, end then system test is confused.

Build plenty of sofoliding, By scaffolding Build plenty of sofoliding, By scaffolding

I mean ell programs and date built for debugging purposes but never intended to be in the final product. It is not unreasonebla for there to be belf es much code in scaffolding as there is in product.

One form of scaffolding is the dummy

component, which consists only of interfaces and perbops some faked deta or some small test cases. For example, e system mey include e sort program which isn't finished yet. Its neighbors can be testad by using e dummy program thet marely reads and tests the formet of input deta, and spews out a set of well-formatted manningless but ordered data.

Another form is the minioture file. A very common form of system bug is misunderstanding of formats for tape and disk files. So it is worthwhile to build some little files that have only a few typical records, but all the descriptions, pointers, etc.

The limiting case of miniature file is the dummy file, which really isn't there at ell. OS/360's Job Control Language provides such fecility, and it is extremely useful for component debugging.

Yet another form of scaffolding are ouxliory programs. Generators for test data, special analysis printouts, and cross-reference teble enelyzers, ere ell exemples of the special-purpose jigs end fixtures one mey went to build.²³

Control changes. Tight control during test is one of the impressive techniques of hardware debugging, and it applies es well to software systems.

First, somebody must be in charge. He end he cione must authoriza component changes or substitution of one version for enother.

THE
fixing of the documented
component bugs will
surely inject unknown
bugs.

Then, as discussed ebove, there must be controlled copias of the system: ona locked-up copy of the letest versions, used for component testing; one copy under test, with fixes being installed; and playpen copies where each man can work away on his component, doing both fixes and extensions.

In System/360 engineering models, one sew occasionel strends of purple wire among the routine yellow wires. When a bug was found, two things were done. A quick fix was devised and installed on the system, so testing could proceed. This change was put on in purple wire, so it stuck out like a sore thumb. It was entered in the log. Meanwhile, an official change document was prepared and started into the design automation mill. Eventually this resulted in undated drawings and wire lists, and a new back panel in which the change was implemented in printed circuitry or yellow wire. Now the physical model and the paper were together again. and the purple wire was gone.

Programming needs a purple-wire technique, and it hadly needs tight control and deep respect for the paper that ultimately is the product. The vital ingredients of such technique are the logging of all changes in a journal and the distinction, carried conspicuously in source code, between quick patches and thoughtthrough, tested, documented fixes,

Add one component ot a time. This precept, too, is obvious, but optimism and laziness tempt us to violate it. To do it requires dummies and other scaffolding. and that takes work. After all, perhaps all that work won't be needed? Perhaps there are no bugs?

No! Resist the temptation! That is what systematic system testing is all about. One must assume that there will be lots of bugs, and plan an orderly procedure for snaking them out. /PC

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delatellender with five (5)-year batstell-up and software unto fineien that automatically insents date line at 1 power on 1. With added say, this unit will turn the comon, perform a function, and then level of.

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Ethernet Compenion

· Ethernet Link

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All versions of ELAN include en Ethernet interfece end equipment to convert voice into data and back again. This enables one to give and receive spoken messages from any location. The SECRETARY is the basic system with these



EXECUTIVE \$2995

- Ethernet Companion . Modem (300 Baud)
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logged onto • Message Manage ment - either elec

either visual or audible

visual or audible · Voice Management -

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NETWORK FOR THE IBM PC

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The EXECUTIVE is the most complete implementation of ELAN, adding computer recognition of spoken commands. An executive might phone the PC to leave or retrieve messages or request specific Information. The PC, in a spoken voice, cen request the user's access code or offer e list of options the user can select. The EXECUTIVE can then key in answers or commands with the phone's tone dialing buttons, or may simply speak his response to the computer.



MANAGER \$19951

- ·Ethernet Link
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How To Choose A Consultant

You absolutely need a computer, right? Everyone else has one, so why not you? And you've seen those ads on television the one where the poor guy with the 85 file actionets full of accounts payable brings in a tiny deaktop personal computer. He just presses e button and everything is fixed instantly, and it's time to head off for Arube with the new blonde from personnel.

ba with the new blonde from personnel.

Maybe. But if your problems are that
severe and your need that great, and if
time and money are that tight, perhaps
you should consider hiring a consultant.

"People who are confident and knowldegeoble about what they want, or people who are looking for a computer to do applications like word processing or simple spreadshest work, for which software is readily available, probably don't need late;" "said one computer consultant." "On the other hand, if you can't get the help you want in a computer store, or if your requirements are special, you should start looking for a consultant."

enftware

PC Mogazine spoke to two consultants who specialize in the micro and minicomputer field—We'll call them "Tom" and

"Jerry."
Engaging a consultant. Tom sald, can range from buying dinner for a knowledgeable friend to paying for an hour to two of office time (at a cost of perhaps \$200) to a full-blown analysis, proposal, purchase, and installation agreement, which could run several thousand dollars over and above the cost of hardware and

"If you're considering buying a PC, or more than one PC, thet's \$5,000, maybe \$10,000 or more," Tom said. "A \$200 consulting bill is not out of line to make sure you get the right equipment, is it?"

both consultants stressed, through, that the emphasis is too often on the hardware. In a custom installation, the cost of software can be two and three times that of the hardware. It is, after all, the software that is the real interfece between the user and the system. A consultant should be able to make that connection as "friendly" as possible by writing an original program, or adapting an existing one to your particular made. Another advantage of customization may be the ability to "migrate" data from an existing system to your new system, or to set up your new system.

"Anybody who can't find a software package that meets his needs, or who locates one but can't find out if it will do what he wants it to, should get some help," Jerry said. "For example, I would never install a full accounting system without a consultant."

Sending Out an SOS

Consultants are not as easy to find as the neighborhood computer store. At least not yet. You may find some listings in the

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"You'll find a consultant the same way you find a lawyer or an accountant," Tom said. "Find someone who has used a consultant and seek a recommendation."

Once you've located one or more candidates, as them for names of clients, too. "Be sure the reference he give you is a valid one, without any hies," from said. Educational and professional credientals are worth invastigating. There are groups such as the Independent Computer Consultants Association (P.O. Box 27412, St. Jouis, MO 63141), or the Date Processing Management Association (SOS Bussel Highway, Perk Ridge, IL 00068) that may be of some halp in making selections.

YOU'LL FIND a consultant the same

way you find a lawyer or an accountant.

The most important thing, though, according to Jarry, is to ask, "Has this person done asactly the sort of work? I'm looking for?" and "What do his clients say about his performance?" You should seek a face-to-face meeting with the consultant. "You've got to find someone who is very compatifie with you," Tom said.

Jarry stressed the importance of concentrating on the consultant's attention to the details of your hastness. "Of course, what he knows about the technical side is important; but at least as important is what he knows about your business. And also, consider what he does ofter the initial meeting. Does he sund you a memo confirming the detail of your of you, and including prices? He should be what to lead to the prices? He should be what to be vary specific, because that is what you are looking for."

Beginning to Consult

Your first conversation with the consultant should include a frank and clear

The Independent Computer Consultants Association

Help! A nationwide association that can offer assistance in finding a consultant

The Independent Computer Consultants Association, which represents more than 3500 consultants in 1100 companies across the country, can offer assistance in finding a computer consultant, according to Steva Epner, founder of the group. Local chapters can refer you to members, or the national office can try end help you directly.

"We do not allow as a member anybody whose major husiness is salling hardware or softwere." Epner said. "We define a consultant as an independent who provides advice to the public for a fee."

the grant offered a few world of the dotter. You should pick a consultant the same way you would hire a high-lenging somebody in to help you, and this parts a school was pilete the financial viames and a school was pilete the financial viames and the same was a school was pilete the financial viames and the school was a school was president or a mean president, you would go out and interview people, you would also to reference, you would look at what kind of work the candiddeen have done in the past.

According to Epane, thekking references is an att. You one is going to give you e bed reference. Left start out by you e bed reference. Left start out by summing that the consultant is helfwey intelligent. You know that when you call, did not be the start of the consultant is helf with the consultant is helf with the consultant is a like to be did meeting early in the morning? Was he always on time? Did he prema near reports or was earlything done orally? Find out whether the work halts consultant in the consul

The Independent Computer Consultents Association can be reached by writing: P.O. Box 27412, St. Louis, MO 63141.

—Karen Cook.

discussion of whet you are proposing to purchase:

· Are you seeking edvice on huying e system? You should establish the hourly rete the consultant will charge to analyze your needs, to drew up specifications, to make recommendations on sources, and for other services he will provide.

E DO NOT allow as a member anybody whose major business is selling hardware or software.

 Are you looking for special services? Do you need help in drawing up e plan for internal review and approval? Do you want essistance in deeling with vendors?

 Are you looking for custom programming? You will be buying the consultant's time as an analyst, his (or his staff's) programming time, and the installation of the software and necessary training.

· Are you esking the consultant to provide a "turnkey" installation? In this case the consultant will do the enalysis, make recommendations on hardware and software, edept the software to write original code if needed, install the equipment and software, and train the users.

Fees for services are completely negotieble, with consulting work typically hilled at a rete ranging from \$25 per hour to several hundred dollars per hour, depending upon location, the degree of expertise of the consultant, and the nature of service to be provided. Programming time is typically hilled at about \$40 per

You should also be clear on who will be working with you. Sometimes the person who mekes the presentation is not the person who will be doing the consulting work. This is particularly true in lerger operations, which may have staffers who specialize only in closing deals.

Reducing the Price

"The more preparation you do before you walk in the door, the cheaper it will be to walk out," said Jerry. Bring as much rew data as you can collect: the number of files, the number of users, dollar volumes, the number of pages of word processing or printing, the types of forms involved, the sort of information you need to collect or anelyze. If the consultant has to pry this information from you or your staff, or if he has to count the files himself, "it's like

naving the taxi to wait." lerry said Another fector you should consider is the amount of time the consultant will require of you and your steff. This is e sometimes overlooked expense, and one that should be weighed in your decision making. Is it cheaper to use your resources or those of the consultant?

This sort of decision is particularly important when setting up e database or other epplications that may require the conversion of noncomputerized files. "Don't pey a consultant \$10 per hour to have him hire someone to enter deta, if you can have it done for \$3.50 per hour," Jerry said.

Buying Hardware

The consultant might offer to sell you the hardware and software as well as giving edvice. This is an area where you'll have to make e judgment: Do you believe the consultant is fairly representing your interests?

O ONE IS going to give you a bad reference.

Buying through the consultant should not increase your costs, by the wey. In fect, some consultants are ehle to offer discounts from list price. Like a travel agent or an interior decoretor, the consultant typically receives a commission from the seller, not the huyer. The seller mey be e retail operation or it may be the manufecturer or distributor, and the commission can range from one-third to one-half of the list price. The money for e consultant is not in

the hardware sale," said Tom, "I don't want the price of the computer to come between me and my client. My income

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comes from the consulting side."

Along the same vein. Tom suggested that the consumer not tie the hardware purchase to the cost of consulting. Treat each element separately to gat the best deal—and maintain the best relationship.

The Consultant as Shopper

Some people who know whet they want—either es the result of their own investigation or after consultation—will hire a consultant as an expert on shop-

ping.
"I'va hed peopla ask ma to go to stores
with them," Jerry said. "In fact, I went to
one store os my cliant. I had the salesman
try to sell me e multi-PC system with nonexistent software. I went back and told my

client to forget that guy."

Another service a consultant might provide is to assist you in obtaining servica on hardware or software. Of course, if you buy hardware from a consultant, he is usually obligated to service it during a warranty period, but you may be able to

gat your consultant to arbitrata between you and a manufacturer for any equipment or software you own.

Striking the Bargain When you've decided to angage a con-

CONSULTANTS' wives have it no better than doctors' wives.

sultant for anything more than e few hours of conversation, you should take the tima to gat e statament in writing of the work to be dona, together with e formal legal contract outlining duties, full specifications, responsibilities, and charges. The contract should state all of the following:

should state all of the following: out in advance.

• Who will own the finished software? "Tva been to the finished software? "Tva been to the finished software."

software which usually ensures technical support, rather than purchasing it outright. Such an arrangement mey elso offer you tax advantages. On the other hand, if you want to own software outright, meke certain your agreement states that as a

condition.)
 Who will maintain software and hardware?

 Will the consultant be on call to help with emergencies or ordinary problems?
 For what pariod of time? Will there be additional charges?

 Whet kind of warranties are offered on the software? On the hardware?

 Whet kind of training will personnel be given? Will refresher courses be offered at a later date? How about new courses for new employees? At whet cost?

Some companies heve found it to their advantage to place a consultant on retainer, guaranteeing access whan needed. Such en egreement should elso be spalled

"I'va been tracked down by clients while I wes on e vecation," Jerry said.

PROTECTION



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"I've gotten calls in the middle of the night. Consultants' wives have it no better than doctors' wives."

Both consultants recommended that

you not pay for a full package of services in a lump sum. Payment should be spread out over the course of the agreement, based on agreed-upon milestones. For example, portions of the hill could be paid on completion of an analysis, drawing of specifications, delivery of equipment, installation of software, and completion of training.

Believe it or not both Tom and Jerry said they had at one time or another sent away a client without a computer.

"I had a Broadway casting agent ask me for help." Tom said. "He had thousands of Index cards with information about actors and he wanted a computer cross-reference. I figured out it would cost him 30 cents to a dollar for each card transferred over to the computer. While throwing the cards in a file cabinet was free. His hudget couldn't and it.

"I have a friend with a drugstore," he

continued, "who set up to record every transaction on a micro. It worked out well when he went home every night and recorded them on the computer himself. But he wasn't making any more money for finding his customers' files faster. His

PAYMENT should be spread out over the course of the agreement.

computer didn't hring him an extra dollar in revenue."

"You have to look at the payback. If you can't answer basic questions on total cost and return on investment, then you need help, and you need to listen to a consultant's advice."

There are also clients who have wasted money, even with the assistance of a consultant. "There's one client I had who was so thick-headed and obstinate he refused to learn to use the computer." Jerry said. "I'm sure his \$10,000 system is just sitting under a desk somewhere today."

If you are to believe ell of the edvertisements for computers and software, the days of the microcomputer consultant would seem to be numbered. Are consultants on their way to obsolescence?

"IBM took the Little Tramp and said,
'This is Everyman's Computer.' The PC
raises everyone's expectations," Tom
said. "It makes some things very simple.
But you still can't press a hutton that says
'cont'."

"The day when any of the program generators really work, and the day when computers are so cheap you can throw one away if it doesn't do what you want it to, consultants will be on their way out," he continued. "That's already coming in hardware, but software is not there yet."

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The basic concept of taxt edventures origineted with the venareble Hunt The Wumpus game, where the pleyer tried to elude the pits in en imeginery maze inhebited by a fierce monster and "guper bats."

The first real adventure was called, approprietely, Adventure, and introduced the idea of puzzles to be solved by picking up objects, moving them around, end doubtings with them. That idea was expended end improved upon in Zork, The Phonou's Revenge, Monater folly, end Storcoss, to neme just e few thet ere now on the market.

If you've ever played e text adventure game on your PC, you've probably thought ebout writing one. I have written six text advantures for the IBM PC and have found that they ere just as much fun to write es they are to play. Maybe more. Maddening, yes. Frustreting, yes. But there is nothing quite like the thill of setting up your own



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............ "Software developers - readle licenses on these and other PCX products are available: "CP/M is a requ-tered trademark of Digital Research: 18M PC and PC-DOS are registered trademarks of IRM. CIRCLE 361 ON READER SERVICE CARD puzzles in your own imaginary landscape and watching people wrack their brains over the solutions

Most of the larger text adventures are written in assembly language for the sake of speed and space conservation. A "large" game is one that has over 200 room locations and over 50 objects. If a game isn't too large, and if speed isn't too much of a consideration, it can be written in any other language-including BASIC.

My own adventure games are built

from two basic parts: the driver program and the text files or "script." The script contains all of the vocabulary words that the driver recognizes, plus the object and place descriptions. There is also a builder program that converts the text in the script to machine-readable tables. Because the games are script-driven, I can build 70 to 80 percent of a new game without ever touching the actual program source

code. The mechanism of the games is rela-

Figure 1: The vocabulary list for the outhor's adventure game, The Phantom's Revenge. Subsections classify the permitted words as motion verbs, objects, action verbs, function wards, and adjectives.

, oi u s, u	na oujecures.
SEC01	VOCABULARY - The Phantom's Revenge
SUB01	MOTION VERBS
1	LOOK DESCRIBE
2	CAVE CAVES
5	BACK RETURN RETREAT OUT LEAVE EXIT
3 4 5 7 3 9	NULL WAIT
5	UPWARD UP U CLIMB ABOVE ASCEND
5	DOWN DOWNWARD DESCEND D
7	LEFT L
3	RIGHT R
9	ACROSS
10	EAST E
11	WEST W
12	NORTH N
13	SOUTH S
14	NORTHEAST NE
15	NORTHWEST NW
16	SOUTHWEST SW
17	SOUTHEAST SE
LB	ENTER FORWARD ONWARD INSIDE
19	ERIC
20	CHRISTINE
21	FANTOME
22	HAM
23	JUMP
SUB02	OBJECTS
1	KEY KEYS
2	LAMP LANTERN
	BARS
	TICKET DUCAT PASS
5	WHISKBROOM WHISK BROOM
5	SHEETMUSIC MUSIC SCORE SONG
7	RAFT FLOAT
3	DOG HOUND POOCH ROVER BOWSER CANINE

CARRY TAKE KEEP CATCH STEAL CAPTURE GET

DROP RELEASE FREE DISCARD DUMP

SAY CHANT UTTER MIMBLE

ACTION VERRS

SUB03

2

Parsers-Simple and Complex

tively simple. Objects, room locations. messages, and command words are identified by number. The driver program accepts a phrase of text as input and parses it. The code number for each recognized word is stored in a variable. These numbers are then used to access tables, retrieve messages, and provide program branch points. All of the objects in the game have "stetes." It is the control of these stetes that allows the pleyer to solve puzzles, move things around, etc.

10 NEW

12 OLD

The parser is one of the most important parts of the program. It is the most visible section of the code, since it evaluates the player's input end displays the "intelligence" level of the game. When you set out to write a parser, you enter the whole complex world of artificial intelligence. Fortunately, adventure games take place in a confined universe, such as a set of caves, where the author can control the objects and the actions. Thus, they can have a limited vocabulary of specific

UNLOCK 5 NOTHING 6 LOCK LIGHT ON 8 EXTINGUISH OFF SUB04 SPECIAL VERBS 50 SESAME OPENSESAME ABRACADABRA SHAZAM HELP. 64 TREE TREES GROVE 66 WAVE SHAKE SWING 68 LOST 69 OPERA 79 HELL DAMM PET STROKE PAT 139 STOP SUB05 FUNCTION WORDS VEC V 2 NO N 3 TO INTO IN AT TOWARD ON UNDER ATOP INSIDE A FROM 5 ALL WITH USING AND THEN AN AN THE SUB06 ADJECTIVES BIG LARGE HUGE ENORMOUS VAST SMALL TINY WEE ITTYBITTY LIGHT WHITE 4 DARK BLACK 5 RED VERMILLION CRIMSON 6 GREEN BLUE AZURE 8 ORANGE YELLOW PURPLE LAVENDER VIOLET

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words

Because of this limitation, it is possible to read each word that the player types in. locate it in a table, end decide whet to do with it. The simplest parsers only eccept a two-word input, consisting of a verb and an object: TAKE BALL, EAT FOOD, Each word is tested egainst the internal tables.

word is found, but the other can't be identified. an error message is displayed that includes the one word that the parser was able to identifu.

If no match is found for either word, the player gets the error display "What?" If one word is found, but the other can't be Identified, an error message is displayed that includes the one word that the parser was able to identify: "What do you went to do with the BALL?" or "EAT what?"

This method requires the program to identify a word as e noun or a verb. in BASIC, one approach would be to set up a noun array and a verb array. To create vocabulary tables in BASiC, you would dimension them with DIM, and enter the vocabulary words with DATA. During game play, a subroutine would be called to validate the input word and store its number in a varieble.

The parser I use is a little more elaborate. It can accept an input sentence of up to ten words and identify a verb, direct object, and indirect object. Either the direct object or the indirect object can be described by adjectives to distinguish them from other objects in the same

For example, if the parser read, "PUT THE RED BALL IN THE LARGE BOX," it would identify PLIT as an action yerb and piece its internal verb number in a variable called VERB. It would then check to see if any object present could be described as a RED BALL and, if so, put its internal object number in a variable named OBI. (Since the vocabulary list shows synonyms, the parser would reach the same result if the player typed CAR-MINE SPHERE instead of RED BALL.) Finally, the parser would identify LARGE BOX as the indirect object and return its value in the variable named INDORI

list for one of my gemes. As you can see, the list is divided into subsections. depending on the word types: motion verbs, objects, action verbs, special verbs. function words, and edjectives. (LOOK and CAVE are listed with motion verbs but are actually handled as special cases. LOOK repeats the room description, end CAVE displays two different informational messages, depending on bow far into the game the player bas gotten.) This data structure lets me use any word I want as a movement word. The last six words in SUB01 are "magic" words that only work In certain pleces, but they are nonetheless motion verbs.

SUB04 contains words that heve no effect on the game, but return e special message when the player enters them. The numbers in the first column refer to the messages, which are retrieved from a separete table

There are really only two types of input in an edventure game. The pleyer can enter e movement request or an action request. Once the input has been parsed.

the program can deal with the request. A movement request is made by typing in a direction, such as WEST, NE, or SOUTHWEST. The driver program reads a location code variable (LOC) for the pleyer's current location, end then goes to a

table to read the allowable move com-

Figure 1 shows part of the vocabulery

mands for that room. If the move is legal that is, one that can be found in the script. the pleyer's location code is updeted and the description of the next room is printed. If there is an object with the same location code as the room, the object description is printed too.

move is legal the player's location code is undated.

i control movement in my games by percentage, by object state, by whether the player is carrying a particular object, and by specially coded controls that do more eleborate checking. Figure 2 shows some sample movement controls, in all cases, the first column contains the number of the player's location. The second column can be the number of the room he will "move" to, a message number, a special mutine number, or even a command to issue e message and "kill" the pleyer.

The third column is a restriction on the move. If there is no entry, the move is unrestricted. The last column contains the words that the player has to enter to make the move. Multiple entries in this column mean that any one of the words shown will beve the same effect.

Suppose that the pleyer is in room number 81 and types EAST. The driver reads the file and sees that EAST is an allowable direction from room 81. If the player types EAST, he will go to room 82. Ah, but the next column shows that there is a condition on the move. N0=9 means that the movement cannot take place if object number 9 (which happens to be a doorlis in state 0 (closed). If object 9 is in state 0, the driver then reads the next line. which tells it to displey message number 10. "You can't welk through a solid door!

If object 9 is in stete 1 (open), the player can "GO EAST." The driver moves 82, the room number, to e varieble called LOC, which is the player's current position, and uses that number to fetch the messages describing room 82 and any objects at thet location

The movement control file for a game by the author based on

81	82	N0=9	EAST
81	M=10		EAST
81	K435		WEST JUMP
82	81	C=4	DOWN
82	M=47		DOWN
82	83	50%	SOUTHWEST
82	123		SOUTH
82	203	S5	UP
82	82		NORTH EAST



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Line 3 of Figure 2 includes K435 in the second column. This means that if tha player is in room 81 and types WEST or JUMP, tha drivar will issue message 435 ("You have just jumped off of a 50-foot cliff.") and "kill" the player.

$I_{\rm F}$

player types TURN THE CANNON, the driver first verifies that TURN is an acceptable verb and that CANNON is a

recognized object.

The fourth and fifth lines of Figure 2

show another move restriction. C=4
means that the player must be carrying
object number 4 to make the move. If he
doesn't bave that object with bim, the
driver issues message 47 ("You can't go in
there without your ticket.")

The next two lines show how percentage is used to control movement. If the player types SOUTHWEST, he will move into room 83 50 percent of the time. (A random number subroutine is called to establish the pass/fell result.) If the player's move falls, the driver reads the next line—which is unrestricted—end moves him to room 12.2. This is the room he would have reached if he had typed SOUTH. The sighth line of Figure 2 instructs the

program to use special routine number 5 if the player is in room 82 and types UP. This particular routine involves checking the player's weight load to see if a ropal ladder will support bis weight. The lost line of the figure shows en unrestricted movement thet returns the player to his starting point.

Action requests ere parsed like movement requests, but the driver goes to a "jump table" to find the code to handle the ection. For instence, if a player types TURN THE CANNON, the driver first verfines that TURN is an eccepteble ver and that CANNON is e recognized object. It then reads the jump teble for the location of the TURN code and executes the

Action is performed by changing the state and the location of an object. For example, the CANNON mentioned above is part of a puzzle whare the player must load the cannon, turn the cannon to face a door, and than fire it to break tha door down to allow entry to the next room. There are three objects to deal with—the cannon, the cannon ball, and the door. Each one of thate objects has diffarent states, and there is a different message for each state.

The cannon can be turned toward the see (state 0) or toward the door (state 1). The cannon ball can be unloaded (0), load-oil (3). The doct and be intact (0) or smashed (1). You may think that it is peculiar to refer to the loaded/unloaded state of the cannon ball, but remember that a set of states we salready used for the cannon itself.

The first step in solving this puzzle is

to load the cannon. The pleyer types LOAD THE CANNON, and the driver checks whether be is in the same place as the cannon, whether he has the cannon ball, and whether the cannon bell has been fired.

Each object in the game has e location once that's bondled the same way as the one for the player. If the location codes for the player and the object match, then the object is considered to be in the same place as the player. (An arbitrary location code of -1 is assigned to objects that the player is "carrying." In the program listing (Figure 3), LOC is the player's location, OBJICO is the object totation array, OBJSTATE is the object totation array, OBJSTATE is the object state array, 25 and the cannon, and 26 is the cannon ball.

ONCE again the great hunter faces danger with an unloaded gun!

The first six lines check the required states and locations, insert the message numbers for errors end branch to the error-handling routines. Error messages 101 and 102 are globel messages, with tha neme of the object inserted: "There is no

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CANNON here!" and "You haven't got the BALL!" Error message 455 is from the specific message table, and says "The CANNON BALL is too mengled to fit in the CANNON."

If there are no errors, the program changes the location of the camno has from the player's inventory to the current room number and sets it to stete 1. Message 50 ("The CANNON is now looded with a 20-pound CANNON BALL.") is selected, and the program hanches to a general routine that displeys the message and waits for the next input.

If the pleyer decided to pick up the cannon ball again (TAKE CANNON BALL), the logic would be reversed. The state of the ball would be changed to 0, and its location changed to show that the player is carrying it.

The next step in this puzzle is for the player to swive the cannon around to foce the door. The correct input is TURN THE CANNON. The cannon only hes two states—facing towards the sea of the door. When you use the word TURN, the program flips back end forth between them. In Figure 4, message 62 says "The CANNON is now aimed out to SEA," and message 63 says "The CANNON is now aimed at the DOOR." The code at line was the property of the code at line of the code at

used in the first example.

Now that the cannon is loaded and

turned toward the door, it can be fired. If it isn't loaded, and the player types FIRE THE CANNON, he will get a sarcastic messege: "Once again the great hunter faces denger with an unloaded gun!"

and a you're the time from Section 2 all in the common is fired when it is a time of our to see, the cannon is fired when it is a time of our to see, the cannon ball will be moved to a location along the basch, set to rate to 2 so it can't be used egain, and the pleyer get a sensage stilling with appeared. If the cannot be sense of the cannot

trol movement in the game.

I use location of or e sort of Never-Never Land, where objects go when the player
er Land, where objects go when the player
can no longer use them. Instead of setting
the cannon ball to state 2, I could have set
oBJLOC(26) = 0 and merely put out 1
messege saying that there was a big splash
as the ball hit the cocan nad vanished.
Either way, the player isn't ellowed to fire
the compon again.

Messages for the different object states are stored in e separate teble, huilt from the script. Each time the player goes to e new location or types LOOK (to request e description of the room he's in) the driver checks for objects at the location. If an object is found, the driver checks its state and displays an appropriate message.

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Dian Crayne is the author of several odventure games published by Norell Data Systems; The Phanton's Reventy The Hermit's Secret, Monster Rally, Valley of the Kings, and Elsinores. She has been a programmer/analyst for 10 years. Her science fiction writings are published under the pseudonym Dian Girard.

```
Figure 3: RASKC pr. grum listing of a reutine to LOAD THE CANNON in Esistence.

2000 IF OBLICA (25) = LOC THEN GOTO 2020 REM cannon here?

2005 INSERT = 25

2005 INSERT = 25

2006 INSERT = 101: 00TO 10500 REM insue error message & exit

2020 IF OBLICA (26) = -1 THEN GOTO 2040 REM player has ball?

2020 IF OBLICA (26) = -1 THEN GOTO 2040 REM player has ball?

2030 OBLERR = 102: 00TO 10500 REM insue error message & exit

2030 OBLERR = 102: 00TO 10500 REM insue error message & exit

2030 OBLERR = 102: 00TO 10500 REM insue error message & exit

2030 OBLERR = 102: 00TO 10500 REM insue error message & exit

2030 OBLERR = 102: 00TO 10500 REM insue error message & exit

2030 OBLERR = 105: 0 = 1 ERM set hall to 10046d

2080 MESSAGE = 50 REM mag - cannon in loaded

2080 OUTO 8000 ARM insular was ease and continue
```

Figure 4: The TURN THE CANNON program segment from Elsinore.

3000 IF OBJSTATE(25) = 0 THEN GOTO 3030 REM cannon aimed at sea?
3010 OBJSTATE(25) = 0 : MESSAGE = 62 REM no, set it = 0
3020 GOTO 8000 REM issue message & exit
3030 OBJSTATE(25) = 1 : MESSAGE = 63 REM yes, set it = 1
3040 GOTO 8000 REM issue message & exit

Figure 5: The FIRE THE CANNON program segment from Elsinore.

3080 IF OBJSTATE(26) = 1 THEN GOTO 3100 REM cannon ball loaded? 3090 MESSAGE = 365: COTO 8000 REM no. issue mag and exit 3100 GBJSTATE(26) = 2 REM set cannon ball = "used" 3110 IF OBJSTATE(25) = 1 THEN GOTO 3040 REM cannon aimed at door? 3120 OBJLOC(26) = 6 REM nove ball to seashore

3130 MESSAGE = 64 : GOTO 8000 REM issue message & exit 3140 DBJSTATE(9) = 1 REM set door to "smashed"

3150 OBJLOC(26) = 82 REM move ball to scholar's room 3160 MESSAGE = 65: GOTO 8000 REM issue message & exit

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A new kind of publishing: PC Disk Magazine, a collection of ready-to-run programs and documentation for PC computers makes its debut.

Launching The Disk (Magazine): We

Have Lift-off

It had to happen: With all of the computer magazines vijing for your attention, now there's a magazine for your computer to rend, PC Disk Mogazine's premier issue appeared in computer and bookstores in mid-fuguat. The product, as its name implies, uses a magnetic disk instead of ink and paper to convey its message. The first edition includes 11 rendy-to-run programs for PC computers, together with a complete munual.

It represents, according to its designers, an entirely new way for authors to reach the owners and users of the IBM PC. 'This is not a magazine on diskette," said Editor Morris Effron. "The printed page is still the best way to convey information for humen eyes. The point of PC Disk Megozine is to convey software in the easiest, quickest, and most efficient manner possible."

The monthly PC Disk Mogazine was developed by Ziff-Davis Publishing, publisher of PC Mogazine and many other popular "conventional-format" megazines devoted to computer users. The first issue had a press (and disk) run of 20,000 copies which will run on any PC or PC-XT or compatible machine with at least 64K,



with PC-DOS 1.1 or 2.0, and one disk drive (single- or double-sided). The magazine sells for \$29.95 at computer and bookstores (\$119.95 for a six-issue mail subscription).

es (\$119.95 for a six-issue mail subption). found was that the less-expensive programs—no matter how worthy—often were not reaching their markets. We look

the means of distributing that work to the user." Effron said, "One of the things we

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CIRCLE 164 ON READER SERVICE CARD

at the Disk Mogozine as one wey for small progrems-works that might not otherwise achiave commarciel success-to be packaged together, duplicated, end distributed as e unit," he said. "We can all

Magazine will include long programs that could not be listed in print, and our software will be debugged and ready to go.

share the tremendous costs of produc-

"This way the product is out there, and the euthor can make some money." Effron continued. "And the usar receives a similar benefit: e collection of programs their may be worth more then the sum of its parts."

Reader Contributions

The magezine will activaly seek contributions from readers for upcoming issues. For details concerning submission, send for the "Software Submission Plen." PC Disk Mogozine, Dept. 732, One Park Avenue, New York, NY 10016. Authors are paid on a per-copy royalty plen, based on seles. "We want our readars also to be our authors," Effron said, "They will determine the content end the success of the megazine."

Effron predicted that the product will appeal to software companies with smeller pieces of software to offer. He noted that the utility by Peter Norton, which is included in the premier issue, is an offshoot of the well-known Norton Utilities. and the bar charting program is an edaptation of work by Jemes Toussignant of Mirror Imeges Software.

"We purposely left the disk in source code end without copy-protection," Effron said. "We want our reeders to look et eech of the programs included end learn bow they work, and we want to make it easy to modify the software for individuel needs."

The first issue includes the following programs.

· Disk Mop, by Patar Norton, This utility displeys e complete mep of any diskette, and can be used in file manegement and as an educational tool.

· Loan Analyzer, to evaluete alternative fixed-payment mortgage and loan egree-

· Automotic Bor Charter, to produce grenhs on screen or on a printer · WordStor Configurator, a manu-driv-

en utility that configures meny of the operating features of the popular word processing progrem

. IBM Motrix Printer Control, to allow easy selection of speciel printing features

including boldfece, italics, end more. BASIC Program Editor, e full-screen editor for source code, including the ability to split screens to displey two separate

segments simultaneously. · Hide and Sink, a battle game on the

high seas. · Pyromid Motch, e geme of memory and reflexes.

· Personal Cosh Flow Manager, the first of a three-part system for the maintenance and reconciliation of as many as four checking accounts.

· Perpetuol Colendor, e utility thet can datarmina the day of the week for env data and the number of days between 2 dates

· Demographic Doto File, containing state-by-state information from the 1980 Census. "The purpose of the Disk Mogozine is

not to supplant PC Mogozine," Effron said, "but rather to complement it. We'll be eble to include long progrems that could not be listed in print, end our softwere will be debugged end reedy to go."

Similarly, Effron said, the package will not be in competition with the mejor software products in national distribution. "Our progrems will complement these packages as well," he said. Effron notad the inclusion of e WordStor utility in the first issue, and said he expected such products as dBose II coding or VisiCalc templetes to be in future editions

Plans for the second issue include another disk utility from Peter Norton, the second part of the Personal Cash Flow Monoger, e date file that cross-references zip codes, telephone aree codes, and Postal Service stete codes, a data ancryption program, and two games.

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DATA PRODUCTS, INC.

Look at any software bestseller list and you'll see Microsoft hugging the top of the chart. PC visited MS Product Manager Tandy Trower to find out why.

The Microsoft Touch

Nosing your way up I-5 to the Bellevue, Washington home of Microsoft, you pass what is left of Mt. St. Helens. A few years back, this mejestic, long-silent dome papped its cork and put the drizzly Pacific Northwest momentarily on the mep.

But there's been an even bigger explosion a hundred or so miles upstate. Microsoft was the brainchild of two local boys who made very, very good: Bill Gette and Peul Allen. These two wrote the BASE/Get and have dominated the field ever since. Their opportung system, MS-DOS, hes dehtomed Cd/M as the industry statedart. There is the state of the destroy of the control of the contr

software, such es the MS Flight Simulotar and the MS/IBM Typing Tutar, has cash registers jingling coast-to-coast.

PC wanted to learn more ebout Microsoft's past languege successes and future lenguege plans, and spoke at length with Tandy W. Trower, Product Merketing Manager of both business and consumer products. Trower is responsible for ell of Microsoft's lenguege, educetianel, and recreational softwere.

The following conversation took plece in Microsoft's offices on the autskirts of Seattle, a bustling metropolis whose cars sport bumper stickers crowing "I V Seattle—the Emerald City." Seattle is about as far away as you can get from Boca Raton and still vote. But it was a nod from IBM—the rabbl's kosher seal of approval—that

ensured Microsoft's preeminence. And sent this reporter winging west.

PC Does Microsoft sell very many nonlanguage, non-operating system products! Trower: We don't do to many products! The products of the products of the season of the close's for in these areas are other close's like 'light' in the control of the products of the product of the controlley well for us. Although we didn't outhor the original version of Adventure, the odoptotion we did for micros has done extremely well. In foct it has done much better thon't expected on the IBM PC, considering it is just ploin all standard into one.

PC Do you have any figures on how many.

IBM PC owners use your operating system?

Tower: I don't have an exoct number. Portila Issocson did research just least December, I think, and her investigation showed that for IBM PCs. more than 95 percent were using MS-DOS, 2 or 3 percent were using CPM-86, and the remoining percent were using the p-System. PC Your BASICs, at least the cassette version, goes out with every single IBM computer, but are there any figures on how

many PC owners actually use it?
Trower: It's hord to soy. That BASIC is
probobly used more than anything else.
Most people use it simply to get
acquainted with the language. I hove not
seen on IBM yet that did not have a disk
drive built in. It's relatively uncommon to
find anyone using one of the smaller

BASICs.

PC: Do you have a feel for how many people who buy IBM PCs use BASIC as opposed to those who just take the BASIC manual out of the carton and put it right in

the closet?

Trower: Not really. The majority of people who buy microcomputer systems generally do so for a specific opplication. They buy MultiPlan or a word processing pockage or occounting package.

I think they probobly spend their space time with BASIC to get acquainted with programming because BASIC lends itself to cosuol use. I suspect that BASIC is used heavily in educotional institutions. BA-SIC is probobly the most frequently used piece of educational computer software around. If you compare it in relotive terms to anything else on the market. PC: Of all the BASICs out there for micros, does Microsoft have the lion's share? Trower: In terms of BASIC in general, Microsoft is clearly dominant. In terms of the BASIC interpreter market, we believe that we probably own greater than 0.95

SEATTLE is about as far away as you can get from Boca Raton and still vote.

percent market share. In terms of the compiler market, we shore that with some of our competitors, most notobly Digitol Research. DRI has two versions of BASIC on the market: their C-BASIC, pseudocode compiler, and their full notive code compiler.

On the PC specifically, I don't hove only figures on how they specifically compore. My guess is thot we probably dominote the industry for the PC os well. There or very few brands of personal computers on the market that have a name for themselves that don't hove Microsoft BASIC running on them.

PC How did Microsoft grab such a huge

share of the market?

Trower: Microsoft come into the micro
industry as it was just starting. Everyone's

probobly heard the troditionol story of how Bill Gates and Paul Allen created a version of BASIC on on 8000 emulotor and took it down with them to the folks at MITS and got it up and running right oway. So it was really one of the first pieces of software ovoilable for a microcomputer.

The other significant event was lining up the customers who come no son offerward—especially the early soles work that Bill and Paul idid with Apple. After all, before he bought MS-BASIC. Steve Worsznico cloredy had integer BASIC running on his Apple. But, Bill and Poul were belt to persuode him that he needed o version of Microsoft floating point BASIC on that machine.

PC: How did IBM become involved with

Microsoft?

Trower: I don't know exactly whot went on, since I wosn't here of the time. Whot I was told was that IBM originally just came to Microsoft, and said, "Sign these nondisclosure forms: we just want to talk to you." Then they sot down with Bill and Paul and discussed what products Microsoft hod. The way that meeting was summed up was, "We'll get bock to you if there is anything we need to talk about. Don't consider this os anything significant. It doesn't mean that we'll do any business with you. It's just that we wanted to come up and talk to you." A short time ofter they had gone, there was onother contact from IBM saving that they wonted to ocquire BASIC.

There's also the story that they wanted

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an operating system to go along with the BASIC. As I understood the story, we referred them down to the folks at DRI. There are lots of rumors and I don't know what the true story is but that didn't work out. So IBM came back up here and said, "Give us an operating system," Fortunately, we were able to provide them with an operating system.

We had been working closely with Seattle Computer Products at that time. They had an operating system running on their system and we had an interest in keeping in touch with them. We are both

are lots of rumors.

small computer industries here-obviously, this is not Silicon Valley-who were keeping in cantact with one another.

Actually, Microsoft back at that stage probably consisted of fewer than 15 employees. We have almost 400 now.

When IBM came up and said they wanted our BASIC. Bill and Paul warked with them on a specification for the language. Originally, IBM anticipated that they wanted to sell this at a low cost, which meant no disk drives, and so they wanted a cassette BASIC. It turns out there are probably very few people who actually use an IBM with a cassette. It was probably o good gamble to go ahead and do It at the time. And the version of BASIC they wanted to do was to be drawn out of the history of some of the things we had done in RASIC

Back then, we had a standardized version of BASIC running under CP/M-80 that we distributed through retail channels. BASIC originally came aut of the 8K product that we sold to Apple, Cammodore, and Radio Shack. We added program development features that become extended BASIC. And then disk drives became a standard part of system, so we

had disk extended BASIC. This then evolved into the BASIC interpreter when CP/M-80 came out

originally came out of the 8K product that we sold to Apple, Commodore, and Radio Shack.

But all along, we had done special versions of BASIC for many of our lapanese customers, as well as same in the U.S. We were very much in the custam industry at that time, and there were lots of customers who had graphics ar saund and wanted extensions for those features. Eventually, we had a base of such features, which



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were not port of our standord BASIC. But we integrated those commands—like the graphic features and the music, the full screen editor, and the light pen and joystick support—into IBM's version, put that all into a BASIC, and then divided it up into the three levels IBM wonted.

PC: Were there any things that didn't get into the BASIC and into the BASIC.

ONE OF THE things that we're doing right now with all of our languages is moving them all into C.

Trower: Not os for os I know.
PC: Is IBM's version the most advanced that you put out?
Trower: Whot IBM has is what we call

GW-BASIC, which is a special version of our BASIC interpreter.

PC: What does GW stand for?

Trower: There ore three things thot people think it stands for Goe is that it stands for Goe Whiz: one is that it stands for Gates, William; one is that it stands for Gates, William; one is that it stands for Gos William; one is that it saw only to different to the GASICS in the past, and this was one yot of different in the that it saw it will be the think of GASICS. We had done. The idea behind GW-BASIC was to build of standardized product. BM's was the first version of GW-BASIC.

PC What are all the BASICs written in? Trower: All the BASICs creted up to the present are written in ossembly code. But one of the things that we're doing right now with all of our languages is moving them into C. It makes them much more portable. Moving from the 8080 to the 8086 is reasonably easy, but moving from 8086 code over to the 88000

is o little more difficult.

The version that IBM shipped was GW-BASIC 1.0. and what we did ofter we dis-

tributed that through IBM was to go even further in our development cycle. We wonted to be oble to toke the same BASIC that we had written for IBM and provide it

THE
problem with GWBASIC is that while it
has lots of nice features,
they're all hardwaredevendent.

for other systems in such o woy that OEM customers wouldn't be dependent on us for customization. It didn't seem reason-oble for us to spend 5 or 6 months developing each new version. We felt that we had o very nice BASIC that to lot of customers were very interested in. But it



CIRCLE 215 ON READER SERVICE CARD PC MAGAZINE 294 SEPTEMBER 1983 wauld be ridiculous if every custamer hod ta wait in line to get his version.

The problem with GW-BASIC is thot while it has last of nice features they're all hardware-dependent. And unless every systems monufocture designed his hordware after the IBM PC, we couldn't outomoticolly just put GW-BASIC on that systems. So we farmed what we colled the GW KIt. Essentially, we took oil the high-level code, the red just of BASIC, and separated it from the rudimentory features that ore hordware specific.

We hove o set of specifications and a questionnoir that we provide to all CEM custamers. They produce low-level code that their engineers can write for their system old more quickly than it would take for our engineers to have to learn about their system and then do the writing. Then they can link their routines tagether with the high-level code of GW-BASIC and hove GW-BASIC up and running very quickly.

Standard GW-BASIC is not the most advanced versian we publish. IBM now offers 2.0 GW-BASIC, which it colls odvonced BASIC 2.0. This is a superset of GW-BASIC 1.0 with the odditional features to support DOS 2.0, and the extra graphics. There are at least 21/2 to 3 dozen customers for GW-BASIC right naw. GW-BASIC is an interesting product, because while it has a standardized set of feotures designed originally for the IBM PC, it's also vorioble, so that customers did not hove to be in ony woy locked in by the feature set of the IBM. If o customer hos greater graphic resalutian than the IBM, he can support a

HE
problem is that in some
sense the IBM is not
even compatible with
itself.

greater graphic resolution; if he can support mare calars than the IBM, ar a greater number of printer parts, he can do that. So, it's possible for a customer to be very closely compatible with the IBM

very closely compatible with the IBM BASIC—as Compaq is—or very different. Very few systems are really different, because IBM's BASIC hos become the standard for the 8086 MS-DOS world. Even so, we do still offer, through our retoil channels, the standard farm of the BASIC interpreter without the graphics and anything that is machine-dependent.

We've contocted most of our customers obout moving their GW-BASIC to 2.0, if they like. IBM's compiler is not standed compiler. If you compiler. By our compiler. By our content of the compiler. By our content of the training the statements (TI). If you took our standard compiler, which desert have those extro extentions, you could compile o program on one chine, provided that the second machine reads a standard 51%-inch MS-DOS (armot.)

PC: Apart from the hardware specific features, are there really any noteworthy dif-

ferences between IBM's BASIC and most other GW-BASICs?

Tower: Customers come to us and soy they want to make their GW-BASIC cleusly composible with IBMs. On a feature by-feature basis, they can be very competible while. He was the some composition of this was mentioned in an orticle somewhere—is that is nose sense the IBM is not even composible with scole yraphics card, and some software runs with cooler graphics card, and some software desent. It Flight Simulator is a sead example.

But, there ore areas where people run into problems when they're trying to see if their version of GW-BASIC will run every opplication out there. When you loak far compatibility, you're looking of the hordware, and sometimes even timing can moke o difference. We found that Flight will be sufficient to the sum of the sum on the IBM look cilks simply because the trings was a little different.

We can suggest woys that OEMs can make their BASIC mare campatible to IBM's. But there's another problem that



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fosters incompatibility. A lot of the early softwore developers found little tricks and routines-I think some were octually published in the IBM documentation-ond they PEEKed and POKEd to those routines. If the hardware is not 100 percent

like IBM's, such tricks moy not work. Also, when you move strings out to o file in IBM BASIC, the buffers for your files are stotic, just os they had been with Microsoft BASIC. This comes out of the history of Microsoft BASIC where file buffers are always stotic. With GW-BASIC, we mode o modification so that these buffers would be dynamic, which doesn't present o problem if you write o clean opplicotion. However, one software developer had a problem with one of his packages. After he would field his strings out to the file, he knew that on the IBM they were being kept in a stotic buffer, and so he'd go back in with his pointer and PEEK, then pull those strings bock out.

Well, good programming proctice soys you don't do that, and you don't so looking around inside BASIC for hard oddresses or routines to take odvantage of. Any softwore that does that on one version of GW-BASIC will be less likely to run under another version of BASIC, because those things can't be identical.

PC: Some of those PEEKs and POKEs are inserted to speed up programs.

Trower: That's why we offer compilers. An interpreter, by its very noture is going to be slow, and the IBM, while it's an excellent mochine, is not running the fostest processor it could. There are mochines on the market today that will probobly run our version of BASIC foster than it would run on the IBM, becouse those other systems were built of a later date and hove foster processors in them.

But speed really hosn't been much of o problem. We've olwovs had the hallmork of being oble to provide o closely compotible compiler with our interpreter. In foct, they're probably greater than 97 or 98 percent compotible. The leftover percentage makes o lot of sense if you understond where the incompotibilities are.

We provide the interoctive environment of the BASIC interpreter, so that you can go in and write your programs and get them all running nicely, and do things like jump out of the program and odd lines. The Interpreter provides many program development feotures. Then when you finish, you can run the program

through the campiler for the speed odvantage; generally a compiled version runs three to ten times foster than its interpretive counterport.

PC: Your floating point standard is differ-

We've continued to enrich the language os much os we con, with the odded GW features. These are probably whot most CEMs who come to us far BASIC now want. They don't come for the standard BASIC; they want the GW-BASIC, partly becouse they want to hove ot leost os much os the IBM does, but loss becouse the extra feotures that we added allow BASIC users to tap into the hordwore capabilities of the system.

Grophics copability is probably the most notable feature of that BASIC, because it's so papular these days. And the obility to drow lines and circles and different shopes on the screen—which



ent from Intel's. Intel uses the IEEE standard. Isn't this a real potential problem? Trower Well, must people who use Intel's numeric processing chip ore more interseted in languages like Poscol ond FOR-TRAN where we hove put 8087 support into the languages. The numbers I have dan't indicate that there are that many PCS out there with 8087s.

PC: That's probably because IBM announced its availability only recently. Six months ego there were only two or three companies that supported the chip and sold the necessary software. Now there are about half a dozen; so it is growing.

Trawer: I'm not denying that there isn't a market for the 8097: I'm soying that most people don't need it. When we first developed BASIC for IBM there woon oossurance as to when and in what quantities that chip would be ovailable. Up to the present, we've gatten mare demand for a decimal-based math pock in our BASIC than requests to move to the IEEE standard.

If we shifted to that standard, it would make some existing software out there somewhat incompatible, because the numeric format and the way dato is stored would be handled differently. You would foce o trade-off in terms of compatibility with what's already aut there.

PC: What about GW-BASIC are you proudest of?

Trower: The graphic routines, the music, ond the extro GW odvantoges have provided significant features far that BASIC.



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gives you same idea of the internal potential of the machine—is very attractive to the OEM because it means that even a child at a beginning programmer can sit

NO MEANS is BASIC a static product here.

dawn and tap into the power that he has in the system.

With the sound obilities of GW-BASIC. far example, you don't have to design any camplicated assembly language routines to try to senerate music out of the hardware, even though all you have is a tiny speaker. Light pens and jaysticks are probably not used for many serious applications, but they mean that there's a level af interfacing to the computer that doesn't farce you to go strictly through the key-

hoord

Peaple want to get at most of the horsepower that's sitting in their computers. And generally the only people who have been able to do that in the past were the saftware wizards, who magically tickled the bytes and were able to produce fantastic pieces of software. The fact that we've built these extentions into BASiC allows even someane an a very simple level ta ga in and experiment with those features.

That's not the aniv avenue that we've taken with BASiC. Because there's been demand from the business cammunity far certain extra features that would heip them write business applications, we have mieased a Business BASiC campiler. a special versian of our conventional compiler, it has a decimal-based math pock that can imprave your precision if vau deal with manetary amounts.

In the past, Microsaft's math pack had been binary-based, which is great for all the different applications BASiC is used far. People use it far educational purpases, engineering, scientific pragramming, business programming, and just to get familiar with camputers. The binary ased math pock is quite sufficient; it actually adapts itself to these different environments. But when you're dealing with manetary amounts, it helps if you

can target your math pack far that. That's a specialty market, sa rather than add those special business features ta aur BASiC, we have created a separate Business BASiC compiler, it is different

MAKE AN honest effort to keep our ear to the users out there.

from GW-BASiC, but cames out of the same root of the tree. We've added extra features like multi-line functions, so it's

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really designed for o more odvanced programmer who needs to write serious business opplications in the BASIC. It's avoiloble for MS-DOS, and is not machine specific, so it will run on the PC.

By no means is BASIC o static product here. GW-BASIC is not the end of Microsoft's BASIC. We get lots of inquiries, and we make an honset effort to keep our ear to the users out there—not just our OEM customers but the people who ore octually using it—to find out whot kind of opplicotions and features they went. PC What do they ask [or?

Trower: There are o lot of people osking for things like ISAM support, and form support. There are o lot of inquiries osking if there will be any way to have BASIC files and Multiplan files tolk together. Many people are still looking for further enhancement to the graphics package because that's very ottractive.

The version of GW-BASIC that we have right now could never fit in an 8-bit system; it could only fit on 16-bit system, so when the technology jumped from 8 to 16

it was o terrific relief; it ollowed us to put all these extra features into BASIC. But even so, everyone would like to odd new features.

A lot of users would like to toke all the versotile BASIC features and make them totally portable, so they would not be limited to one mochine. Users ore realizing that there's a greater world out there than just the IBM-PC; that IBM has motivated o whole realm of 16-bit systems.

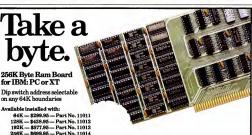
People would like to see more program development features built into the BA-SIC, utilities for searching and finding text, and the copacity to reploce text. There have been suggestions for some sort built in cross-referencer. A number of things that ore in BASIC now could always be oppended os utilities. Now that we have an environment, we put just the choicest things in the BASIC.

PC: Generally, do upgrades coincide with upgrades in DOS?

Trower: Yes, that's o good point. With BASIC os well os with all our languages, we're limited in terms of what we can do by the environment we're in, which is, friendly, why im glot dot most of our 18-bil work is done in operating systems that we're very founding with, such on Shot and Xensi. Bill Cotes has mentioned sor and Xensi. Bill Cotes has mentioned sor and Xensi. Bill Cotes has mentioned sort of the company or a whole are to be able to provide enough support in the operation when the provide enough support in the operating systems so that people don't have to go coround the operating system to try to write their code, which olways leads to incompatibility from machine to machine to machine to

Right now, one of the biggest drowbacks is providing o generic form of BASIC that ollows you to do screen positioning. That's o hardware-specific functioning into the operating system, and perhops take the graphics out—there is no reason why graphics support has to be in the language—we would make old of people hoppy.

have all those graphics features in the operating system? Trower: Right. To hove some sort of sup-



PC

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port for people who want to do screen positioning, so they don't hove to make calls to the hardware and write routines to do II. Instead, they should be oble to call directly to the operating system and hove the operating system provide that environment.

PC: Is this a general trend you see happening?

Trower: Yes. There is definitely o commitment on Microsoft's part to increase the functionality of the operating system to make software more portable.

PC: Apart from GW-BASIC and the two compilers, are there any other BASICs that will work on the PC?

Trower: We sell our products directly to IBM, which basically selfs them as if they were their own products. In addition, we have our retail outlet. In March of this year we started rolling out our MS-DOS language products.

We've put oll of our standard languages under MS-DOS os well. So we hove our standard BASIC interpreter, the core of whot GW-BASIC is built on—if you stripped owey the graphics and the screen positioning you come down to standard MS-DOS BASIC—and we have a standard BASIC compiler also for MS-DOS, and we

HERE is no reason why graphics support has to be in the language.

hove the Business BASIC compiler. All these products ore designed for MS-DOS systems, so they'll run on the IBM, the Wong, the Compaq, the TI, and others. PC: Have you heard any complaints about

Trower: One of the things that has been most surprising to us is that people especially in the 8086 family of processorbased computers—still feel restricted,

since the programs ore limited to 64K of code, and 64K of dote. In the 8-bit tores, if you have the BASIC interpreter and the operating system in there, you have who there is left to do your program. Now in the 18-bit orea, with some of BASIC's house-keeping in memory, you get doout 60K or 61K of program space, which is more than the whole you have your space, which is more than the whole you have you have have been supposed to the whole you was the program of the whole you have the whole you have ever had before.

PC: But if you're up to the 60K area in programming, shouldn't you be writing programs in other languages?

Trower: Thot's whot we hod thought. But many people really expect to be oble to program in a large space, even in BASIC, though they hove more than twice os much as they had previously.

We're looking for olternotives in the 8086 world to see whot we can do in that area because people do comploin obout their program space or their dots space. Same of these people who ore writing serious opplications how tremendous amounts of dot to store, long-oranys for instance, and even though users hove o lorger environment than they have ever



hod before, they still soy that if they have a 512K machine they'll want to use all of it for BASIC.

It's o little unreol to me, but I can understand why they would like to use more than they hove. People didn't soy "Aho! We had more space than we had before." They soid "How come you don't let me use my full mochine?" That's one oreo where we are looking at how we best can provide alternatives.

For example, you con get around the space limitorion in Business BASI of linking seporate code program modules together. No single one of them cogether. You can be longer thon 64K but you can link several of them together. You can till limited of dot but by linking modules together, you can use more menory then you can use more memory than you can use more memory than you can use more semony than you can use the semon of providing odd of the semon of providing both the semon of the work in the environment that we're in.

PC: Earlier you mentioned 68000s. Is that because some of the code you now write is for 68000-based machines, or is it because you think that chip is going to assume a dominant role in the future?

Trower: It's obvious right now that the dominant chip out there is the 8086 fomily. It's hard for me to say whether this will continue to be the cose. Obviously, there is a voriety of chips in that family that will

EVEN
in BASIC, people
expected a larger
program space, even
though they had more
than twice as much as
they had previously.

handle some of the limitotions of the current one. PC: How do you keep in touch with end users to hear how they feel?

Towers Well, on the PC specifically, people how questions and call us because they know we originated BASIC. We find they are somewhot frustrated by the foct that we generally cannot proude only the property of the property of the property of the property of the provide support for the product and tho cur contract with IBM soys that they will provide support for the product. That's as all should be recommended to the provide support for the product. That's as all should be recommended to the providing fixes, or well for we storder providing fixes, or the removal contract that the provides the providing fixes, or the providing fixes, or the providing fixes or the providing fixes, or the providing fixes, or the providing fixes or the provided fixes of the providing fixes or the providing fixes o

this mean you are going to do things like tutorials, or is if just sort of an end run to help users who have these kinds of questions? Trower: The publishing group is o new enterprise here. We get comploints someenterprise here. We get comploints some-

enterprise here. We get comploints sometimes, that people don't feel—as in the cose of BASIC—that the monuols are really tutoriol enough. Well, they were never meant to be tutoriol; they were reference

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documentation, and a lat of people would like to hove samething that introduces them to our languages. I think the book publishing route will be oble to help fill that need on that we'll probably publish some books that motch aur products. That will not only enhance our sole of the product but will help people became mare

familiar with the products we have. PC: Do you have a master plan far the continuing evolution of BASIC, or is it just a question of adding mare and more refinements and utilities with each successive generation of DOS? Does Microsoft philosophically feel that BASIC should become the lineus france of computing?

Trower: Well, since BASIC helped Microsoft get started, and is a product that brings customers to Microsoft, we have a cammitment to it. We feel it's o very vioble language, and olw oys has been. While it was originally develaped far educational purposes, it's turned into a longuage that is used far all types of develapment.

I think we'll be very cautious not ta let it turn into a tatal hadgepadge. We try very carefully to screen what we feel are important enhancements to add to the product. The product is by no means static or dead, and we will continue to enhance it and add features.

THERE is definitely a demand for enhancement of the Business BASIC side of the language.

What is its future directian? Right naw we have GW-BASIC with its graphic features, and we have Business BASIC. There's no reasan at all why thase features have to be totally separate. So there is some cansiderotian an haw to better interate these two families an the tree.

Rabats are another patential area far

BASIC. Obviously, you need to be oble to program thase things. I can't say that Microsoft will definitely move in that orea, but it is an area of interest. They are essentially computers on wheels; that's how Androbat touted their system. We may da a special version of BASIC for such specific morket niches.

There is definitely a demand for enhancement of the Business BAIC aids of the longuoge. This is really interesting because we also sell COBOL, so we obviously believe in COBOL, so And it is probably mare appropriate to talk about COBOL in onicro ward now than ever before because it is o fairly large language and generally is run only on large systems. Same people cansidered it o miracle that it ever fit in an 8-bit swelf in an 8-bit swelf.

There are people naw programming on minicomputer BASICs and COBOLs, wha ore interested in moving their applications down into the micro environment. They really couldn't realistically look of that befare because 8-bit micros just didn't provide a large enough environment.



ment. But now you have 16-bit micros that have larger programming space, and hard disk drives for lorge storage capacity. PC: What about sauping up BASIC with really advanced features?

Tower: In some respects we have some rother odvanced features right now in GW-BASC. He went-trapping features, for example. What you are octually doing a setting a programmable interrupt that sits there wotching and waiting for something to hoppen while your BASIC program is processing all this other stuff. When you find that situation they have you find that situation they you company you can go off and target the control of your program somewhere else.

PC: You just came out with Lattice C-

what's your connection with Lattice? Trower: We basically felt that C was a very important longuage to have. Although we have a version of C running with our Xenix operating system, we didn't have anything for the MS-DOS operating system. To be honest with you, even os fost os this company is growing, there are only a certain number of things that we can do and it's a motter of picking ond choosing whot opportunities exist. it seemed reasonable to us that if there was a good product out there on the market satisfying a need in on important part of our product niche, we would work out a licensing arrangement to distribute it rother than spend the time to go ahead and develop it.

PC: What are some of the others that were nicked up?

Trower: Our new version of Lisp, It's specifically torgeted right now for the RP. CW to soy it runs on the FC. It also runs under CPM-460. We eare moving through o transition right now where it will become a continuous contraction right now where it will become a contraction right now where it will become a contraction right read to the contraction right read to the contraction right read to the contraction of the right read to the right read to the RP. Cond now they might be different on the MS-DOS system. Lays was congrided from one we felt that it was a good product.

we jett that it was a good product.

PC: When you do samething like this do
you fine-tune it ar da you release it without making any essential changes?

Trower: Well, in the cose of both Lisp and C, the only thing that we do is repockage. There is same difference between the C that Lattice sells through Lifeboat and the one we'll sell, but nathing that we really **C**

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monkeyed with. The difference is that we have version 1.04; Lattice has 1.03 out right now. They gove us a version that was o little more advanced—there is an object

 VV_E

believe in COBOL, too.

module disossembler in our version that isn't in the other one. They'll eventually put out that enhanced version through Lifeboot as well.

We also put our library monager and our linker in it for all of our 16-bit longuoges. We included the linker though most people get that with MS-DOS anyway; we wanted to make sure people had

PC: Lattice offers a large library of subroutines. Do you also offer that? Trower: No.

PC: Will theirs work with yours?
Trower: It should work just fine.

Towers a southern are put of the put of the

ment if it's significont enough.

PC: Is your Pascal compiler a version of IBM's or your own?

Trower: Well, essentially IBM's Poscol is

our Poscol, os well. They come from the some source, and the version of Poscol we distribute through our retoil chonnels is o slightly more recent releose thon IBM's. PC: Can you give us a list of the languages

PC: Can you give us a list of the languages that you do sell?

Trower: For MS-DOS-based machines, we

hove the BASIC interpreter and the BASIC compiler, Business BASIC compiler, our COBOL compiler, Poscal, FORTRAN, C, and Lisp.

PC: What about LOGO?

Trower: No. LOGO is o very interesting language It's primarily being used right now in educational communities. PC: Is it a fast-growing market?

Trower: Definitely. I con't soy that our eves ore closed to LOGO, Generally, our strotegy in the post hos been to provide longuoges for programmers. I'm not soying that LOGO isn't a language for programmers, but ot present, it's more of o computer literocy longuoge. In some woys, we're wotching it very corefully becouse that's how BASIC got storted.

PC: Are there any other languages out there that are going to be important for the micro market?

Trower: There ore other longuoges out there. I've heard of versions of RPG for micros and versions of Dibol. There are odherents who love FORTH.

PC: Do you think that between C and BASIC and the others Microsoft produces. you have the market covered?

Trower: I think we provide probably the best in terms of the widest possible range of longuoges right now.

PC: Do you see one language taking over in the future?

Trower: I see C becoming very significant. I don't know that it will take over. People adopt to certain languages and become comfortable with the features those longuoges provide. From the programmer's viewpoint, C is great, because for most people who program in ossembly languoge it's o very notural progression to move into C

Someone coming out of a more traditional language environment would probobly find C o little harder to get used to because he wouldn't have all the built-in functions that he used in his other languoge. I see C becoming very significant in program development. We hove o lot of ongoing internol projects where we move o lot of our softwore into C.

At Microsoft, we're also involved with programming on o different level. If you think about it, the Multitool products really ore almost o programming environment for end users. When you put together o spreodsheet, in o sense you're programming that piece of softwore. It's not programming in the traditional sense of FOR-TRAN or Poscol, but there are formulos that you're putting in; you're establishing relationships; and you're setting up certain variables

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ming os well os the troditianal kind. There's o lot of effart right naw gaing into our Multitaol family of products, thot will let users da such things without having ta know anything about programming.

T IS
probably more
appropriate to talk
about COBOL in a
micro world now than
ever before.

PC: Will there be a shell that ties all the Multitool components together? Trower: We da affer a product, sart af a

shell far MS-DOS, although it's certainly not samething that ties everything together. But it's the first step. It ollows you to laak at your directory and paint at different things. It bridges the gap between the Multitaol products, by taking the interface we've been very successful with and giving users o means of using MS-DOS in that orea.

PC: What you seem to be saying is that in the future, hard core programmers will use C, and beginners will use same type of programming-like tools that don't require coding. BASIC is caught in the middle. Will it always be around?

Trower: If you're talking about 20 years from now it's a little hard to say. I think there's still o long life ahead far BASIC. I don't see onything in the short term that would preclude BASIC from not continuing aut there.

BASIC is a language that people ore exposed to mare thon only other softwore that's oround. When they buy a personal computer they moy not always indulge themselves in working with it. But people like BASIC. It's the only thing thot really provides them on opportunity right naw to get familior with their system so that they can actually control it.

If this is somehow reploced with an environment that ollows people that much occess without having to ga inta a traditional language, it's possible that people might nat use BASIC anymare. I think that's still a lang way off.

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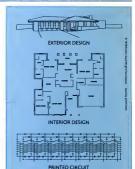
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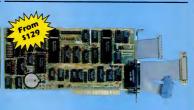
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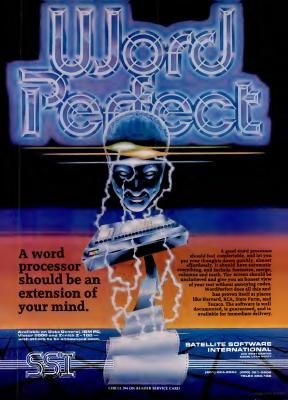
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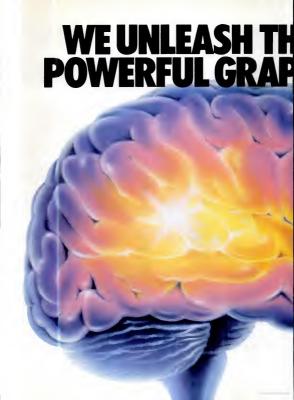












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Programming needed to provide this capacisty.
 In practice, disk capacity limits file size (s.g., s single sided disk with 200 characters/record will become full at about 700 records).

IF YOU'RE CONFUSED **ABOUT BUYING A** PERSONAL COMPUTER. **HERE'S SOME HELP**

Computers come in two parts.

One part is the "hardware," the machinery itself. The other is the "software," which tells a computer what to do, the way a driver tells a

car what to do Without software, a computer can't do anything. And vice versa. You have to buy both.

Buy the software first.

Since the reason you're buying a computer is to get the capability the software gives you (remember it's the software that tells the computer what to do), it makes good sense to nick the software first.

Start by making a list of the things you want the computer to do. Possibilities include word processing, inventory control, accounting, graphics, recordkeeping-you name it, there's probably software that does it.

Next take your list into a computer store and ask the salesperson to demonstrate software that

will do the things you want. Even though you'll need a computer for the demonstration, keep in mind the computer is just a vehicle. The software is the driver.

picking the rest of the computer system will be that much easier. The simpler the better.

Some people will tell you that software has to be complicated to be powerful. Nothing could be fur-

ther from the truth

Good personal software should be, as the computer people say, "friendly." Meaning that it helps you do what you want to do without getting in the way.

Good software keeps the complications in the computer, where they belong. And keeps the capability at your fingertips. It's that



the way we think a software family should be: simple.

straightforward and powerful.

Currently there are four software packages in the family: PFS:WRITE. PFS:FILE, PFS:REPORT and PFS: GRAPH, with more on the way. Here's a little more about each of them.

PFS:WRITE. The simplest way

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And when you're through revising WRITE shows you "on-screen" just how your document will look when it's printed. So there are no surprises afterwards.

WRITE also works with most popular software programs, including the PFS Family of Software.

This feature allows you to add names and addresses from mailing lists to generate form letters. Or combine columns of numbers or craphs with your text.

PFS:FILE. The simplest way to get organized.

FILE is basically a paper filing system without the paper. So you can record, file, retrieve and review information in a fraction of the time it takes with a

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PFS: REPORT. The simplest way to sum it all up.

REPORT is a powerful analysis tool that works with FILE. REPORT sorts through your files

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LANGUAGES/ PAUL SOMERSON

Is BASIC a serious programming language? What are its main flatus? Will other languages supersede it? What changes does Microsoft have up its sleeve? Microsoft's Guru of BASIC, Mark Chamberlin, offers PC some surprising answers.

In Defense Of BASIC

Walt—don't turn this page, unless your computer came with a green eyeshede, and you're the kind of tunnel visionary who uses your PC exclusively to poke dolar emounts into apreachaset cells. Not that there's anything wrong with financial planning. But ignoring the PC's astonishing programming ability is like visiting e nucle beach just to admire the driftwood.

Say the word programmer to meny people and they conjure up images of asociel computer nerds hunched over bulking consoles and cacking demonically es they transfer phony million-dollar occunits in a distant Bank of America mainframe, or tap Into NORAD to send squadrons of fighters scrambling for nonexistent redar blips. These days, however, this couldn't be farther from the truth from the truth.

IBM doesn't give anything ewey for res, but it does provide copy of Microsoft BASIC hardwired inside every PC it makes, (In fact, Microsoft hes distributed well over a million copies of its BASIC in various incamations and dialects, You can run BASIC even if you don't own a single floppy; boot your PC with the drive door open end no disk in the slot end Cesseste BASIC filekers onto your monitor.

But while IBM wented BASIC in every mechine, it didn't make the language easy to learn. The femiliar olive-drab manuel is an excellent reference book, but a terrible teecher. It is possible to learn BASIC by plodding pege-by-pege through the manual's elphebetical listing of functions, statements, end commands, but few people ments, end commands, but few people ever do. IBM or Microsoft really should publish e separate BASIC tutoriel, on manuel or disk, or Include e few Instructive chapters in the conventionel BASIC manuel. Utter novices need to pick up e few fundamentals before they start, so they don't go epoplectic when they stare at e line like "A-A+1."

Forced Thinking

There is e thriving market in third parphase and the part of the clarity and class of an 1BM manuel. BASIC is so simple that even the worst of these books can have a read enup and confronting his first syntax error in an hour or two. Meny PCers learn from books like these, or from increasingly popular classes given et colleges and computer stores. Why are so many PC owners learning BASIC and waxing enthusiestic

ebout the joys of programming? Several reasons. Some like the idea of mastery over mechinery. With e modest knowledge of BASIC you reelly can put the PC through its peces, make it do virtuelly whetever you went. Some like the puzzle espect-figuring out how to turn an idee for e program into the code necessary to make the program work. Others eniov the grephics It allows even non-artists to produce, or get e tingle out of tinkering with sounds and enimetions. Many like the wey BASIC lets them whip together e program in minutes to handle complex methemetical calculations or other business needs.

Programming forces you to think or get the computer to perform swe to smallest operation you have to break the smallest operation you have to break the stak into minutely simple steps, consider end protect sgainst sill the possibilities for error, and then find weys of expression cally. Most people stop thinking methemically the day to the test meth final exam in college, checkbook balaning notwithstanding. After so meny in a it is a genuine pleasure to use the methter of the protection of the state of the graph of the state of the state of the graph of the state of the state of the graph of the state of the state of the graph of the state o

If you spend enough time crenking out code, you were begin looking at even goods, you were begin looking at even untertained by the deferrently, enelyzing routine teaks it life differently, enelyzing routine teaks we eutonestically end bereaking them into their various logical steps, organization into their various logical steps, organization. There is a sudden concern for efficiency. There is a sudden concern for efficiency, analytical, calculating. The gangle brist-tle You see something that's not exhibit the you see something that's not exhibit the gases upstairs begin whirring modely.

Programming As A Strop

All computer lenguages heve a limited vocabulary. It is ruel challenge to define e complex series of instructions with the fewer than 200 functions, commends, and statements aveilable in BASIC. And each of these program-building blocks has its own demending syntax; put e comma where e semicolon should go and your entire program mey go heywire—or crash



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terms, according to the IBM BASIC manual, "the distinction between a command and a function is largely a matter of tradltion. Commends, because they operate on programs, are usually entered in direct mode. Statements generally direct program flow from within a program, and so are usually entered in indirect mode . . . Actually, most BASIC commands or statements can be entered in either direct or indirect mode . . . A function is used like a

If you're not familier with the above TRICK OR TWEAK

The editors of PC Magazine announce the first "POKE Your Way to Fame and Fortune" competition.

For years, PC users have been discovering new programming wrinkles not mentioned in env IBM or Microsoft BASIC documentation. Some of these are extremely useful, or even necessary. For instance, common patches allow users to check on the state of their NumLock, or force all keyboard character entries to be capitalized. Other, more sophisticated tweaks ellow you to run e program like dBose II in color, or create entirely new palettes on the medium resolution graphics screen.

Microsoft and IBM both discourage using such "undocumented" features in your programs, and they do have a point if you're hemmering together a piece of commercial software. The reasons they give make sense from their perspective: Microsoft wants to be eble to export its BASIC to every MS-DOS machine on the market and hardwere-dependent PEEKs and POKEs that work on the IBM mey cause havoc, or simply do nothing, in other systems. IBM wents to be able to change its ROMs-and introduce slightly different models-with impunity. And what IBM wants, IBM gets.

The World According to Microsoft dictetes that instead of PEEKing and POKE ing, you should write polished, highly commented and structured code, then run it through its compiler to speed up axecution. No arguments here, except that Microsoft also frowns on including "undocumented" feetures, end that its compiler costs \$300. Also, compiled programs are not easy to tinker with

But the most important point is that there ere serious deficiencies in BASIC

and the PC herdware that you can correct by using such clever software patches. We certainly agree with Microsoft that designers of serious applications softwere should be wery of incorporating such tweaks if they want their programs to be portable. But for someone inventing a game for his child or a utility for himself. the more tricks he knows, the better able he is to get et all the horsepower of his system.

Have you figured out e way to bypass the cold-boot self-diagnosis? Or e trick to continue running, if you choose, after the PC spots a parity error? Or a clever scheme for getting more than the usual number of colors in graphics mode? Can you scroll your screen from side to side, or up and down e pixel at e time? Or pley music using two voices rather than the one provided? Or run both color and monochrome simultaneously? Or unerase in WordStor? Or perform some other miracle so stupendous it makes all these other suggestions look feeble?

Contest Details

Send us your best original, uncopyrighted programming secrets, and the editors will pick the ten we feel are most ingenious or useful. Winners will each receive \$50, and their entries-along with their names, unless otherwise specifiedwill be printed in a forthcoming issue. Mail them by November 15, 1983 to: Programming Contest

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-P.S

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varieble in an expression to call a predetermined operation . . . "

Commands can do things like run, save, load, and list programs, displey files,

MOST PEOPLE stop thinking mathematically the day they take their last math final exam in college.

or jump from BASIC to DOS. Numeric functions can take one number and produce its contino, or chop off its decimal portion, or use it to generate a random commerce. String and the string of the strin

Each line of a typical program "listing," (the display of a program's contents) contains one or more instructions, written in the arcane "Code" that the computer will understand Languages like LOGO and BASIC come closest to being understandeble. Others, like APL and FORTH are nearly inscrutable to the innocent bystander.

The Joy of Coding

Witting good code is an art. Programs can be tersely elegant, or long-winded and clumsy. There are always several ways to get the same computer job done. Skilled code-writers can often accomplish in ten lines what brute force programmers do in fifty. There is much room in programming for cleverness.

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uncertainty is not much of a problem when you're writing programs. While the first law of coding is that there's elways a slightly shorter, better way to do it, e program either runs or it doesn't.

BASIC is an easy language to learn and use. It is a vary "high" lavel language.

PERIENCED programmers universally seem to view BASIC with hauteur and disdain.

which means that it is closer than most languages to English. To run e program you simply type RUN. To print "hallo" you tell the computer: PRINT "hello". There's even a "direct moda" that lats you use parts of BASIC the way you would a calculetor.

And the most popular version of BASIC is "interpretive"; users can slep a program together and run it right away. Most other languages (and even two other varsions of Microsoft/IBM BASIC) are "compiled," which means that programmers have to perform additional, timeconsuming steps after writing the program, before it will run. However, once a program is compiled the first time, it will subsequently run much faster than its

interpretive counterparts. Partly because BASIC is slow comparad to the more esoteric compiled languages, and partly because it is the language of beginners and is oftan written very inelegantly, experienced programmers universally seem to view BASIC with hauteur and disdein. These days,

"It's written in BASIC" is a statement that is whispared, not shouted from rooftops. While it's true that if you have to write an operating system or a word processor

do so in C or Pascal or FORTH or assembler, BASIC is good for garden-variety programs, end just perfect for learning how to

write code. You can grasp volumes about the language and ebout programming simply by loading BASIC into your PC, typing someone else's short program listing onto your screen, and then experimenting with it. If one line of such a program says: FOR A=1 TO 10, and you change it to read: FOR A=1 to 20, and then type in RUN. you can see the effect instently. (In this case, the length of a loop-a reiterative series of instructions-is doubled.) IBM supplies many such short progrem listings

in its manual. Do Not Enter

Interpretive languages can be very interactive. This is necessary for all but the slickest programmers, because the hardest part of writing programs is invariably "debugging" tham. Once you've keyed in the initiel program, you have to fine-tune your code to correct any errors, handle unusual and unanticipated inputs

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(to take into account, for instance, headaches that arise when you ask a user to type in a number and he or she types in a letter, or a negative number, or a zero, or a number too big for the computer to handle, or a number with commas, or two numbers), and make sura it does every-

thing you wanted. BASIC is extremely interactive. You can run partially-written programs, or jump to the middle of a program and run one part you're trying to fix without having to wait for the program to cycle through from the beginning. You can throw in a statement to freeze the operation of a program at virtually any point. and have it print out the value of all important variables at that step in the program-in effect, take a snapshot of the program at any stage and have it tell you exactly what it is doing, and show you what is working proparly and what is

not

Best of all, when you have to debug your BASIC code, you can alter a program quickly and aasily, than try to run it to sea if the change you just made fixed tha problem. If one change doesn't work you can quickly try another. BASIC's onscreen editor, while far from perfect, does offer certain sterling features that make program creation and adaptation a snap. The PC's customizable program keys can turn aditing and repair jobs from a chore to something automatic. The keyboard be-

OUNDERS Bill Gates and Paul Allen are right out of central casting: brainy boy millionaires bristling with energu. ideas, volunteered opinions on everything.

comes an extension of the fingers and the brain

For instance, by defining PC function key #3 as : "Key 3, CHR\$(2)" and PC function key #4 as: "Key 4, CHR\$(6)" you can skip forward through a program word-byword by tapping F4 and backward by

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Figure 1: Function key settings used to run graphics programs on the PC's graphic screond then switch effortlessly back to the text screen for debugging. Note the use of initial CHRS(27) choracters to ovoid syntox errors with BASIC's line-screen editor.

100 KEY 1, CHR\$ (27) + "CLS:L1ST" + CHR\$ (13) 110 KEY 2, CHR\$(27)+"RUN"+CHR\$(13) 120 KEY 3, CHR\$(2) 130 KEY 4, CHR\$ (6) 140 KEY 5, CHR4 (5) 150 KEY 6, CHR\$ (27) + "RENUM 100" + CHR\$ (13) 168 KEY 7, CHR\$ (27) +"SCREEN 0:" 170 KEY 8, "WIDTH BO:COLO" 180 KEY 9, "R 1,7,21CLS"+CHR\$(13)

190 KEY 10, CHR\$ (27) +"CLS"+CHR\$ (13) pressing F3. Other keys-and combinations of keys-do everything from running and listing the entire program, to erasing from the current cursor position to the end of the line, to renumbering all the lines. And they can be customized for spe-

cific problems If you ever write graphics programs that use the IBM grephics screen, you'll probably want to switch back and forth between graphics (to see if the code works) and text (to fix it when it doesn't). As soon as you run such e program the PC turns on the medium resolution graphics

screen. This is fine for making circles but terrible for listing code, since this screen is 40 characters wide rather than the standard 80, and limited to a bizarre combinations of colors like white on purple. It could be a genuine nuisance to have to go through the laborious steps that will get back to your text screen, make it 80 characters wide again, set the colors that are most reedable on your monitor, clear the screen, then list the program. But if you first set your function keys with the trivial program in Figure 1, you can do all this in

1 -- LIST (and ENTER)

NEXT HORD

110 -- CLS (and ENTER)

RUN (and ENTER)

-- ERASE TO END OF LINE

RENUM (and ENTER)

WIDTH/SCREEN/COLOR/CLS

PREVIOUS WORD

tion keys (7+8+9+1) in quick succes slon.

Boy Millionaires

The IBM PC version of Microsoft BASIC is an enhanced version of Microsoft's generic GW-BASIC, which in turn is a descendent of the original BASIC-80 Microsoft designed in 1975. As with most customized dialects of the language, the enhancements are largely hardware-specific. All MS-BASICs share the most important commands, functions, and statements But IBM's edition is souned up to take edvantage of its reletively sophisticated graphics, sound, and other hardware abilities

The early days of MS-BASIC, aka GW-BASIC, read like a pulpy Horatio Alger story. Founders Bill Gates and Paul Allen are right out of central casting: brainy boy millionaires bristling with energy, ideas, volunteered opinions on everything. And these days everyone listens; after all, these wizards have the Midas touch. Friends at a Seattle high school who cut their teeth

PPLICATIO

about e half second by banging four func-

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on e DEC minicomputer, these two went from being proprietors of e homebrew data processing company called Traf-O-Data to micromoguls et the company that owns the operating systems and languages for just ebout ell the smell new computers on

the market For the umpteenth telling of it, the tale goes something like this; Getes and Allen found themselvas et e tender ege in the employ of a Seattle computer firm with instructions to diddle the compeny's PDP-10. Hi-tech TRW wes ebout to go belly up with e project in the boys' backyard to put all the power generated by the Columbia River basin network of dams and dynemos under computer control. The computer? You guessed it, e PDP-10. The two techie tykes stepped into the breech, performed thair systems megic, and saved the dey.

A few years leter, an Albuquerque, NM outfit called MITS officially spawned the age of micros by screwing together e comnuter it named the Altair, Gates end Allen sew e writeup in Populor Electronics and decided the Intel 8080 chip at the heart of the hardware made this particular gedget e winner. They suggested to MITS pioneer Ed Robarts that they compose a BASIC package for the Altair. Roberts admitted others were on the track, but asked to see their submission.

Here's where the story works up the lump in the throat. Allen glommed the specs and spant sevaral weaks creating an Altair simulator on his DEC mini, in effect turning the big mechine into a silicon copy of the little one. After e month of frenetic hecking end tweaking, they called Roberts to make sure no one else hed beaten them to the BASIC punch. Allen hopped e flight to New Mexico and on the plane ride down realized the pair hadn't designed e bootstrap loeder for their program. So in e sweat he scribbled one down 30,000 feet up. Neither Gatas nor Allen had avar touched e real liva Altair before Allen nervously loaded their handiwork. It worked perfectly, the first time it was tried. Now you know why IBM loves these guys. They're superhuman. They cheated ell of Murphy's Laws. You can almost see Rod Serling wandering into the frame as the spooky familiar theme music sifts up in the background.

MITS bought it and the rest is history. For you history buffs out there, everyone was heppy until e compeny called Pertec purchesed MITS. The progenitive pair lib-

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PC MAGAZINE 331 SEPTEMBER 1983

erated a copy of the language, hied to Seattle, and sired Microsoft. In the succeeding years. Microsoft sold its BASIC to virtually everyone out there with a micro. including Apple and TRS.

Boards and Acorns

During this time the company also cobbled other 8-bit and 16-bit languages, and created a piece of hardware that changed the face of microcomputing. Microsoft by then was cruising through the Z-80 CP/M market, leaving competitors in its wake. But the phenomenally successful Apple computers were based on an oddball chip, the 6502, that wouldn't run Microsoft's software. Allen decided to make a Z-80 add-on board that would soon have Apples by the hundreds of thousands purring with Microsoft programs. The remarkable fact here is that there are now more Apple CP/M users than those using any other microcomputer-and Apple wasn't even designed to use CP/M. Allen's SoftCard, and Microsoft's reputation as software mayens, sent ripples through the

industry.

One splash went clear across the country to IBM, which was burriedly tinkering

VER THERE is the mainframe wrapped around the next two versions of DOS and god knows what else.

with a new micro it internally called the "Acorn." Virtually nothing in IBM's computer was proprietary, except the overall design and the logo stamped on the front. Here the facts cloud somewhat. Microsoft's account, at least the one making the rounds, is that IBM knocked on its door wanting the standard dog and pony show. This pext item strains a whole lot of credulity, but according to one top MS staffer. Microsoft referred Big Blue to Digital Research. There is a Rosemary Woods gap in the tale here, and a short time later IBM came running back to the Pacific Northwest with an order for BASIC, an operating system, assorted other languages, utilities, and games.

Why does IBM bardwire BASIC into the PC? It obviously feels the language isn't going to just dry up and blow away. Neither do even the most ascerb microcynics. For one thing, there's nothing on the horizon to take its place. For another, BASIC is stuffed to the gunwales with goodies. Finally, it is still growing, evolving to meet the rigorous needs of today.

To find out more, PC decided to make the pilgrimage to Bellevue, Washington and consult the Guru of BASIC, Microsoft's Mark Chamberlin. Chamberlin is stamped out of the standard Microsoft mold: young, skinny, affable, articulate, wbip-smart, industrious, circumspect. His office is at the very end of a crinkum-

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crankum labyrinth of corridors, and is tidy, almost spartan. The focus of the room is his DEC terminal, which beeps insistently every few minutes as urgant electronic mail snakes through the walls.

DOS Under Glass

Microsoft's plant is e pair of clean, lowsing, modern offices that stradied as freeway. The locals give directions by awing look, for the lig Bamada Inn: Microsoft's right in back of the Denny's resseurent." The buildings in Banta Corner of Bellevue seom to floet in tiers of parking lots crowded with japenese cars. The cars ell look panking new. The buildings all open makes the particular of the panking and the panking area. The makes the solid overhunden of clouds. It is all white and sparkling glass. The people are cheery. They loxy you in the eye and say things like "howdy." This is all very disconcriting to a visitor from the east.

The staff at Microsoft is very security conscious. Thick, unmarked wooden doors pepper the hells. The receptionist makes e little badge for you with e heed-

lina-type machine. It says "visitor." You don't need the label. You end up gawking. Over there is the mainframa wrapped around the next two versions of DOS and god knows whet else. In a corner are knots of whisparing Japanase carrying small equipment cases I'd give plenty to peek

into. Walking by are some awfully young executives who control the destinies of microcomputer owners of all denominations. Through Mark Chamberlin's large pic-

ture window is the most incongruous specicle of all is little rad farmhouse on a spentle hill, and a little red barn, with a little red barn, with a little dog anephing at dragonflies in the little year —e single iush ecre of Washington state workure hemmed in by terraced parking lots specting ranks of Toyotes. Off the distance Man and Pa Kettle putter the particular couple are millioneires having sold the back 39 to the Ramada people and the Denny's people and the Microsoft paople. There are millionaires

avarywhare here.

Chamberlin on BASIC

Chomberlin ogrees that detractors find BASIC an easy torget, and odds that in some ways the criticism is justified. He offered his thoughts in defense of BASIC, and told PC whot Microsoft has in store in the future to counter such criticism.

People who say "BASIC is not really a suitable language for doing careful river are not looking at what BASIC is good for. Whet they're really saying is "There a particular application, and maybe BASIC in 'all that suitable for doing it." But from the beginning, Microsoft BASIC which we call GW-BASIC—has been the one language that has ellowed the user to me language that a lower to the Thew is no other language that comes close to GW-BASIC in allowing users access to their hardwars as well.

It's true that BASIC is to some degree unstructured, and this does allow people to write unstructured programs. But it cartainly doesn't force tham to. You can easily write structured programs. There are a

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few things missing at the present time in Microsoft BASIC. If we had those features—and we will have those features then BASIC would quickly become a language that would encourage good, structured programming.

Inside Story

What's missing? The most important thing is subroutines with local context: local variables and the ability to pass parameters to the subroutine. Local context also means that the line numbers are local to the subroutine. Also, it is important to be able to use alphanumeric labels as opposed to line numbers. As a practical matter, anybody who's written BASIC programs of any size knows that the line numbers can really be a problem.

There are versions of Microsoft that do support labels. It's certainly true of the Microsoft compiler, but I want to focus on the interpreter, because that is the product that most users see. And the compiler is intended to be just a means by which you can optimize the performance of your

BASIC program and also perhaps protect your source code.

What's also missing is simply an extended IF ... THEN ... ELSE. The way our IF ... THEN ... ELSE is defined, it is restricted by the line length; we have a limitation of 255 characters. I don't encourage packing as many statements as possible onto a line, which many people now

COMPATABILITY is an issue that has been at times a real problem for us.

do; that is not a good programming technique. People use it because they know it's a little bit faster and they know that it conserves memory to some degree. MS-BASIC allows you to "nest." to say IF ... THEN and insert multiple statements, and then ELSE ... and then insert other multiple statements. But all of those statements have to the one logical line of 255 characters. The simple way to get around this is to use an IF statement that is followed by a THEN clause and an ELSE clause that can be on multiple logical than the contract of the contract o

bersome.

And even with those three major enhancements, there are still lot of small-things we could do, all of which we are considering or working on. We can put in better debugging copilative for example, although the current debugging tools are and trace of IT (ITOPF) and can evely considering or working on. We can put in and TROS of IT (ITOPF) and can evely considered the control of the current debugging tools are and TROS of IT (ITOPF) and can evely control to the control of t

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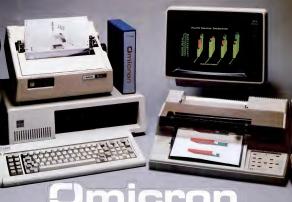
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and continue. Or output a trace to the printer. You can't do that now, and that's such a simple thing to change.

High and Low

There are several main directions for BASIC. One is that BASIC has to become more structured and have better program development features for people using it as an implementation language to create such things as business packages. People have actually written epplications pr grams such as general ledgers in BASIC. The real key to success for e software house is to write programs that are portable. And obviously, the way to do that is write them in high level languages. Microsoft BASIC is evailable on virtually every desktop machine. For a while there was a slight absence of Microsoft products at the very low end, but I think we're making a strong comeback there, particularly with our new MSX. So there's a real incentive for program developers to write programs in Microsoft BASIC, but of course they sense some of the things that are lacking

that I've already spoken of. And to move in that direction, Microsoft BASIC has to

add those features.

BASIC doesn't have things like Find

THERE ARE
all sorts of rumored
optimizations that
simply don't work.

and Replace and a full screen editor instead of a line-oriented editor. And hat's one direction that our BASIC is heading—toward a higher level of sophistication and stillly. On the other hand, and the still of the still, and the still of the still, and the still of the still, and the still of the still of the still, and the still of the sti

Here's an interesting question: What defines the specifications of a languagewhat the language will do on a given implementation or the documentation that comes with it? Many users claim it should be the former, and that's what it comes down to, but I honestly believe it should be the latter. What's happened over the years is that Microsoft BASIC has been released in a large number of machines and each implementation may have some anomalies-not bugs per sebut rather, hidden features, People find these things and start using them. This causes some pretty severe problems in terms of compatability.

And compatability is an issue that has been at times a real problem for us. For example, people write programs in our BASIC for the BBM FC and they use things like PEEKs and POKEs. You can't move that program over to another machine and run the GW-BASIC and expect it to work properly. It's really amazing to me how many programs written that way are in widespread distribution.

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When people first sterted porting their applications to the IBM PC, they were in a hurry, and they wented to exploit the features of the mechine. They weren't thinking in terms of the greeter MS-DOS market. Now those developers are probebly realizing that there is a whole class of mechines hare, not just the IBM PC. Whet developers really ought to be doing is writing GW-BASIC-competible programs, not just those for the IBM PC.

But to the degree that any BASIC features are undocumented. I'm actually in fevor of their remaining undocumented. Wa really heve a commitment to maintain compatibility with the ones that ere documented. Progremmers using the feetures that are not documented will have to pay the price if they ever want to move that application.

Undocumented Woes

By using these undocumented features, programmers make it impossible or difficult for us to be innovative. There are enough of these cases where there heve actually been problems, GW-BASIC has been moved to quite e faw so-called IBM competible mechines, and there's been a substantiel effort on the part of those manufacturers to datermine what progrems run and what programs don't.

know of any language available today that has a better debugging interface than our BASIC

We don't have our own compatibility test. The reason for this is that we no longer ere in the business of porting GW-BASIC to specific herdware. That work is done by the original equipment menufacturer (OEM). We took our GW-BASIC and defined a machine-independent Interfece to that BASIC. When en OEM customer licanses GW-BASIC, we give him a kit that conteins the object code in relocetable modules for e high leval code of BASIC, es well as a specification for low level routines that support the hardware-dependent feetures of the lenguege.

Usars are constantly finding simple undocumented hints that can save execution time-like saving FOR A=1 To 10 . . . NEXT rather than FOR A=1 to 10 ... NEXT A. For e long loop the first way is

faster. This development falls into an interesting category, along with things like packing as many statements as you can par line, leaving out remarks statements, putting subroutines at the top, and defining the variebles that you use most often at the beginning of the program.

it's unfortunete thet people have to be



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Suctions

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aware of things like the fact that programs will run faster if you leave the spaces out. As a practical matter, omitting spaces will speed up a program. This has been influencing programming styles, and I'd say adversely. Should you use NEXT A or just say NEXT? From the point of program legbility it's better to say NEXT A.

There are all sorts of rumored optimizations that simply don't work. For instance, with earlier versions of BASIC, even some in use today, a program runs faster if you use shorter line numbers. But it's not true with the IBM PC.

Step and Fetch It

Speed is not always the most important factor in programming: It depends on the nesture of the application. I would never write a program using those optimizations mentioned above. If I felt that it was necessary to get all the speed possible, I would write the program in as structured a would write the program in as structured a form at I possibly could: then run it through a compression program. People do this all the time: the second program.

takes all the remerks and unnecessary spaces out of the first program, and performs other time-saving tricks. For instance, if you use long variable names in the interpreter, you're going to pay both in terms of size of your program end in speed. The interpreter does truncate varieble names automatically, but only of 40 characters; not too many people are running into this limitation.

There's a case where we know we need to make an improvement. Using variable names that are longer then two or three characters is a very good idea in terms of legibility and maintainability of the code. What comes out of compression programs is a fairly cryptic-looking &ASM; program but it runs faster, and programmers don't suffer the consequences of barriags written it that way in the first place. They still that way in the first place. They still that way in the Rist place. They still have repeated the still the still the still place that the still place that was the still place that the still place the still place that the still place that the still

Should Microsoft publish a book thet tells users whether it's best to put subroutines at the beginning of the program? I

tory notes

here mixed feelings about that because I don't want to emineze any such proximaming standards. I want to believe that people can write good programs without havening to worry about implementation details, and it's my job to make sure that the language allows them to do that. We heren't met thet goal 100 percent yet. But we certainly will in the deskup PC environment. People will be able to write proximam without having to worry about

increasing speed by using such tricks. With micros, the most important idea is to make BASIC a better development language for applications. That's not to say we're not going to aim for eny innovation in terms of end user features—such as enhanced graphics and sound capabilities—because we certainly will.

STOP on a Dime

There are definitely some debugging improvements that cen be made in terms of indiceting where the errors are. Pointing to the errors is importent, as is being able to separate points in the program.

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You can actually do that now: you can add PRINT statements that will trace your variables, and you can insert STOP statements. But that's not good enough because you want to be able to do it without having to start the program from the beginning each time.

One of the things that will come in a future version is the ability to just say STOP on a particular statement when you arrive there, or execute 10 statements and STOP again, or STOP when a certain variable is modified, or just PRINT a specific variable out every time it's modified. Those are things that would make the interpreter far more valuable for debugging programs.

I don't know of any language available today that has a batter dabugging interface than our BASIC. To fix a problam with a compiled language, you have to go back to the source code and put in PRINT statements and then recompile and link and execute and half an hour later maybe you'll have an answer to what was wrong. It is true that we can make interpretive BASIC much better than it currently is. but I cartainly think it's the only practical way to debug. If you write a BASIC program you should develop it with the interpretar, and if you are concerned about speed you should then compile it.

FEK AND voke really ought to be reserved for special occasions.

Most of the people who write articles about "Why BASIC is a Bad Language." are generally computing professionals, (or salf-appointed computing professionals). But PC purchasers who bave never programmed before are going to love Microsoft BASIC because it will let them gat to the full power of their machine in short order. And I just don't know of any other way thay are going do it. Those people are not going to go out right away and read Pascal manual-not that I'm saving there is anything wrong with Pascal as a language; it's a good structured language but it isn't for novice programmers. Unless you're going to argue that only programmers should program computers, than you can't make the argument that BASIC is a bad thing because it allows nonprogramers to program. That should be viewed as a good thing.

One problem for many programmers is the stata of the documentation. There are certainly programming aids that can be implemented inside BASIC but there are limitations to how many. On-line tutorials about BASIC are quite good-a good concept. Although I think it could be somewhat belpful to build belp into BASIC, it's not realistic to think that doing so will give novices enough information to learn how to program.

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type a question mark, the computer will show me ell the commands that start with that letter. Once I've typed a command name I can type a question mark again and it will show me all the possible things that can follow legally. We can do that in

Basic has a fairly long life expectancy.

BASIC and we may very well do it. But I seriously doubt whether that will be sufficient as an instruction device: it's there really just to remind the user who is already familiar with the system. It's not going to teach novices how to program.

Dangerous POKEs

One of BASIC's real strengths is its ability to develop programs quickly and interactively. For writing utilities that do translations on files, the string capabilities in BASIC are really very good. Sometimes I'm amazed at how fast you can develop a program like that.

In some weys I wish that we didn't offer the ability to PEEK and POKE; they are very useful but they're dengerous, and people tend to use them more than they should. They reelly ought to be reserved

for special occasions. One problem we face is whet to put in our manual to make such an edvenced feature clear. How do we explain in detail what something like the INP function does? I alweys say-and meybe this is a bad attitude, but I don't think so-that if someone is going to use something like INP, he will have to know enough about whet he is doing that we don't need to make the explanation any clearer. To have a tutorial on how to use INP is ridiculous because it's not something that someone who is et e beginning level should be playing around with. In order to come up with realistic examples-and I think you do have to include exemples when you have a tutorial-you will lose that novice user just in developing the example to explain what INP or PEEK and POKE are used

I'd much rather put features into BASIC to support such things than to tell somebody to use PEEK and POKE. What it really comes down to is that when you incorporate such advanced statements and functions into your program, you're not writing a BASIC program anymore: you're writing an assembly language program. And there is no way to explain these things easily; it's a whole separate topic. I don't feel any remorse over the neophyte user's not being able to understand exactly what to do with PEEK and POKE.

I think the right direction here is to create utilities that allow the user to experiment and write effective progrems without getting down to the bit level. It's definitely a good idea, and it's something Microsoft has considered.

BASIC Fan Mail

Will another language come elong that will supplant BASIC? I don't know. Remember that while everyone hears complaints about BASIC, the people who are doing the complaining are not the average end users. End users are generally very pleased; we even get fan mail.

And what other interpretive language could offer the features of MS-BASIC? Not LOGO at this stage of the game. It's okay for drawing pictures. And educating children, because in the course of drawing those pictures, they learn some valuable concepts. I think that BASIC has a fairly long life expectency: I don't think that anything's going to replace it. But I think there is a possibility that the day will come when people won't be so concerned

about programming languages anymore. People program for two reasons. First, because they have an application or some need and there's no software available to do the job. This will change because es more software is available and as applications become more intelligent and more user configurable, the need for the user to do his own programming will vanish.

The second reason people program is because they love to do it. It's quite evident that this reason is not going to go swey. People who have no practical reason to do so still write programs in assembly language. There's no explanation for this other than it's a lot of fun. Microsoft BASIC lets you get at the power of the machine. I can do things in Microsoft BASIC that I could otherwise do only in assembly language.

Mark Chamberlin doesn't have to sell me on BASIC: I cen't get enough. The wrinkle, however, is that Microsoft is said to be in the process of transleting most of its software from 8086 assembler into C. So is just about everyone else in the business, including MicroPro. It sure looks from here as if in a year or two we're all going to be using some sort of Unix/Xenix operating system (written in C, of course), doing applications programming in C. and having fun with BASIC. And now that Microsoft has picked up Lattice's highly regarded C. Bellevue, Washington will be your one-stop programmers' shopping center. The folks from DRI aren't so sure. Or the crowd at Wetsoft, or the few other language factories. And there is a hushhush development in the works that may really shake things up. Stev tuned. /PC

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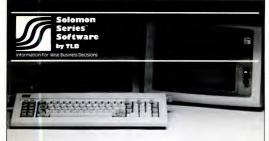
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function as if a complete word had been typed in. These command abbreviations are the first letters of Auto, Cls, Delete, Edit, List, Load" (enter L"), Merge, New, P (= LLIST), Save, and Un-NEW, The Un-New command restores a program accidentally erased by typing NEW.

Entering a period as the first character will list the current program line, while PgUp and PgDn list the previous and the next program line, respectively, Ctrl-PgUp and Ctrl-PgDn will list the first and last

Figure 1: Features of the XREF and FIND modules. Various listings can be displayed by using BDS's XREF and FIND commands lists all variable references to the screen

X, lists all variable references to the printer X.p lists all variable references, starting with p lists references to p only lists all BASIC keywords and tokens F,"kw lists all keyword references, starting with kw F"kw lists references to kw only F. "88" lists all string references starting with ss

F"kw1+kw2 lists only those lines in which kwl and kw2 appear F "kwl.kw2 lists references to kwl, and these are replaced with kw2 displays the contents of the next line containing a reference to a previous F "kw or F "ss" command

Figure 2: The BDS SAMPLE BAS program

'This is a REMark DEFINT H. I DBL.PRECISION# = 4#

HEX VALUE = AHFFFF B.STRINGS = "This is a string" SNG. PRECISIONS = 50000001

IF DBL. PRECISION# > SNG. PRECISION THEN GOTO 180 DIM ARRAY (4) FOR INDEXT = 1 TO 4 ARRAY (INDEXT) = INDEXT '2

NEXT INDEXT

A.STRINGS = "This is a string" + ", too!" 130 140 YEAR = 1982

PRINT "End"

PC MAGAZINE 360 SEPTEMBER 1983

program lines.

The final command within the XBAS-IC module is SYSTEM TRON, a Trace On command with a difference. Instead of filling the screen with line numbers, a single line number is displayed in the upper right-hand corner, and program execution halts until a key (any key) is struck. Then the next program line is executed, its line number is displayed, and the program haits again. Thus it's possible to step through an entire program line-by-line, while keeping an eye on program flow. By holding any key down, the program is executed at the normal keyboard repeat rate. So, in a long program it's easy to skip ahead quickly and slow down when and where needed. Typing SYSTEM TROFF will disable this single-step trace mode.

SYSTEM TRON and SYSTEM TROFF may also be used within a program, as in this example.

200 IF A = 4 THEN SYSTEM TRON

The XBASIC features are convenient: the user takes them for granted aimost immediately. However, it's the other modules that really show off the BASIC Develcoment System. For example, XREF and FIND display various listings, as shown in Figure 1.

Note that a period provides a screen listing, while a comma is used for a hardcopy printout, "kw is any BASIC keyword or token (IF, THEN, +, =, etc.) and "ss" is simply any character string

To illustrate the X and F modules, try the following lines: 30 PS = "A string variable"

Figure 3: Typing F. in the BDS SAMPLE.BAS program lists all keywords and tokene.

+	130						
-	30	40	50	60	90	100	130
>	70						
DEFINT	20						
DIM	80						
FOR	90						
GOTO	70	120					
IF	70						
NEXT	110						
PRINT	150						
REM	10						
THEN	70						
TO	90						
	100						

Figure 4	Tymina Y	in the	pne	CAMPIE	DIC	 -11	- Marin

1	90			
2	100			
4	80	90		
1982	140	50		
5000000!	60			
4#	30			
LHFFFF	40			
*150	70	120		
A.STRING\$	130*			
ARRAY(80	100*		
B.STRING\$	50*			
OBL. PRECISION	30*	70		
4	20			
HEX.VALUE	40*			
1	20			
INDEX%	90*	100	100	110
SNG.PRECISION	60*	70		
VEAD	1.400			



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40 CS = "An unlikely string variable, containing %#P\$3.2"

Typing X P\$ will displey P\$ 30*, indicating that the variable P\$ is found in line 30. The asterisk (*) will be explained shortly. PS also eppears as a character string in line 40, but this can be ignored. And, so typing F "P\$" finds the P\$ character string in line 40, while ignoring the varieble of the same name in line 30.

To further demonstrate these and other BDS modules, the SofTool disk contains the SAMPLE.BAS program shown in Figure 2. (SofTool suggests investing little or no time trying to understend this progrem, since it does absolutely nothing other than show off the system). Figures 3 and 4 displey the printer listings produced by the F and X commands.

In Figure 4, the asterisk preceeding listing 150 indicates that this is e reference to a line number. The asterisks following the references in columns 2 and 3 indicete that the value of the variable in question is changed et these line numbers. Thus the while INDEX% eppears (unchanged) three more times, twice in line 100, and once in line 110.

The VARIABLE DUMP module dis-

JUPER RENUM seems to be goofproof, and will not overwrite an existing program line even if you try.

plays some or all variables, along with their current values. This can be especially valuable for displaying numeric variebles thet are not otherwise seen. For instence, your final value for, say, P2 is based on e calculation in which YEAR is supposed to equal 1941. However, typing wrong here. How did YEAR get to be 1982 when it should be 1941? Try typing X YEAR. If you get back YEAR 140°, you're on the right track. That's the line in which the value of YEAR got changed.

SUPER RENUM offers all sorts of enhancements to the familiar RENUM command. In fact, program lines can even be resequenced; try this one.

- 10 'first line
- 20 'second line
- 30 'third line
 - 40 'fourth line 50 'last line
 - R15, 1, 30, 40 [ENTER] 10 'first line
 - 15 'third line
 - 16 'fourth line 20 'second line 50 'last line
- In other words, lines 30 to 40 were

Figure 5: The BDS SAMPLE.BAS program listing after going through the COMPRESS and UNCOMPRESS modules.

COMPRESS module DEFINT

T-DBL PRECISION#=4#:HEX VALUE =& HFFFF:

B. STRING="This is a string": SNG.PRECISION=5000000!:

IF DBL. PRECISION#>SNG. PRECISION THEN 150 80 DIM ARRAY (4): FOR INDEX =1 TO

4:ARRAY (INDEX)= INDEX2: NEXT INDEX: GOTO 150

150 PRINT "End UNCOMPRESS module

DEFINT H, I

DBL.PRECISION# = 4# HEX. VALUE # = &HFFFF 40 B.STRING\$ = "This is a

string" SNG.PRECISION! = 5000000

IF DBL.PRECISION# > SNG. PRECISION! THEN

DIM ARRAY! (4) FOR INDEXT = 1 TO 4

80 90 ARRAY! (INDEX%) = INDEX% 2 100 NEXT INDEXS

GOTO 120 120 PRINT "End"

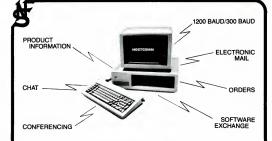
value of INDEX% is changed in line 90. YEAR displays 1982. Something's WHICH ONE CAN RECALL 20,000 CHARACTERS? CHARLIE TELIOS

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moved to a new iocation beginning at 15, and incrementing by 1. Typing R 30,10, 15,16 will get you back to the original sequence. Typing R I (a,b,c,d) will duplicate (at line a) the program block defined by the last two numbers (c,d), without

removing it from its original location. R U scans the program for undefined lines, without renumbering the program. SU-PER RENUM seems to be goofproof, and will not overwrite an existing program line even if you try. Instead, you set an

error message, and the listing remains unchanged.

Once your program is up and running. COMPRESS will speak it to a minimum size, removing unnecessary blenks, extendence color to the control of the control o

nonexecutable lines.
UNCOMPRESS puts a compressed program back into a more-readable format (see Figure 5), although it doesn't restore remarks. (SofTool would like to hear from anyone who can figure out how to do that little trick. Call collect.)

MANUAL. No, it's not another module. It's the documentation, and it's really strange. Obviously, the SofTool folks know nothing about the proper method for doing these things. This manual is written

to Baylish, a language rarely used for software documentation. The problem with English is that too many people understand it, and it makes the BASIC Development System look like it's doing something that's well, understandable. The have told them to toos in some DEF SESCs. a couple of USRs, and a six-pack of PEEKs and POKEs. That way they could have belified more of us, and orobably charged

BASIC Programming Tools

three times the price.

From Symergistic Software comes as et of the programming aids for the Bruning aids for common is that both peckages are designed to make BASIC programming a little easier—all right, a great deel seate—all right, a great deel seate—all Faght, as great deel seate as a sccassible as any of the usual BASIC vocabulary.

By contrast, the BASIC Programming Tools are, and remain, five separate BASIC programs, all of which are assumed to be on the default disk drive. The programs are called EDIT, NUMBER, UN-NUMBER, SUPER LISTER, and STRIP, described in the manual as follows.

Figure 6: Example of BPT EDIT program. The program is written without line numbers and saved as an .SRC file, and the NUMBER program creates a numbered ASCII file. (Note that line 50 has replaced the (CALCR) labels with the appropriate line numbers.)

```
A = 2
                              10 A = 2
R = 4
                              20 B = 4
C = 6
                              30 C = 6
                              40 INPUT K
input k
on k gosub (CALC1), (CALC2)
                              50 ON K GOSUB 80.110
print p
                              60 PRINT P
                              70 END
end
CALC1 ' . . first routine
                              80 '.CALC1. first routine
     p = c * b
                              90 P = C * B
                              100 RETURN
                              110 '.CALC2. second routine
CALC2 ' second routine
p = b - A
                              120 P = B - A
                              130 RETURN
return
```

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EDIT—A full-screen text editor, designed as a replacement for EDLIN.

NUMBER—Converts a source file written without numbers to an executable

BASIC program.

• UNNUMBER—Removes line num-

bers and substitutes line labels as required.

• SUPER LISTER—Produces an enhanced listing (screen or printer) of a

BASIC program file.

• STRIP—Analogous to BDS's COMPRESS module.

When writing a BASIC program, how do you decide on a line number for your first, second, or for that matter, tenth, GOSUB or GOTO? Do you write the subroutines first, or just choose a number sufficiently far away to stay out of trouble? Whatever you do, it's a pretty safe bet that sooner or later you'll get into a bit of

RENUM trouble.

You can avoid all of this with BPT's EDIT program, in which you write in BASIC without using line numbers. For example, if you need some calculation subroutions, just write something like ON K GOSUB (CALC1)(CALC2) and then write the subroutines with a line beginning CALC1 '. (optional name), as shown in Figure 6.

THIS MANUAL is written in English, a language rarely used for software documentation.

The BPT editor reassigns the function keys, and displays the new labels across the bottom of the screen. (These may not the control of the screen. These may not four function keys acroll the text up or down by one or four lines [F] = 1 line up, F= 4 lines down, etc.). F3 splits the current line into two lines. beginning at the current line into two lines. beginning at the current line into two lines. beginning at the new course perion, while F9 joins he new current lines for the screen state of retrieves the last line removed, while F9 retrieves all lines recently removed. F9 removes a single line, and F10 inserts a blank line. Figure 7 gives a few course lab lant line. Figure 7 gives a few course.

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Figure 7: Examples of some of the function keys in BPT's EDIT mode.

Pressing F5 A = 3.14 * B: PRINT "A = ": A becomes A = 3.14 * B PRINT "A = "; A Pressing F6 X = 4 - B: __ Y = 27 + Ybecomes X = 4 - B : Y = 27 + XPressing F9 A = 10 B = 20C = 30becomes A = 10C = 30 Pressing F10 A = 10R = 20 becomes

A = 10

B = 20

of the use of these functions.

With the exception of the first line of a subroutine, all program lines must be indeoted a few spaces. This is no problem, since a single stroke of the Tab key sets a own left margin, which remains in effect until you use the back-Tab function (shifted Tab).

Once the editing is done, you must exit the EUIT program (Esc U) and theo run the NUMBER program to find out if your program works. These actions create a source file (.SRC) containing the unnumbered program, and an ASCII file (.ASC) conteining your program with line numbers, as seen in Figure 6.

At this point the user may have second thoughts about the edvantages of writing unnumbered programs. For a relatively complex editing job, the potential power of BFT's EDIT mode is obvious: You don't have to bother keeping treck of where all your subroutiness are. However, one little typiog mistake in the EDIT mode can produce some beffling surprises during NUMBER, For example, let's say to Figure

6 the comma between the braces in OM. FOGUSE (CALG) (CALG2) was omitted. COSUB (CALG1) (CALG2) was omitted. Since the NUMBER program puts CALG1 at time 50 and CALG2 at time 110, time 50 now becomes ON K COSUB 60110. Assuming there is no line 60110. and that K = 1, you get an error message (under 160 diese number in 500, which at 60 diese number in 500, which at 60 diese number in 500, which at 160 diese number to 150, which at 160 diese number to 150, which at 160 diese number to 150, and time year. If K = 2, the program does not brotte to line 110, and timey take a lot longer to soot the error.

Referring again to Figure 6. if the space between CALC1 end the single quote had been omitted during EDIT (CALC1: .etc.), then the NUMBER program will produce the error message "CALC1 undefined in

THE PROBLEM
with English is that too
many people
understand it, and it
makes the BASIC
Development System
look like it's doing
something that's

line 50." If you run the program, you'll get a syntax error, and line 50 will read ON K GOSUB (CALC1), 110. Well, that certainly is a syntax error, but it was caused by a typing error elsewhere—that is, on what is now line 60. However, line 60 now reads ROUTINE, and your ectual typing error bas disappeared!

understandahle

To quote from the BPT manuel. "At this point, you have to make a decision about corrections. If you mouldly the ASC file using BASIC's built-in editor, your SRC file may become obsolete. If you go back to the SRC file to make every little chaogs during testing, you waste a lot of time."

To me, one of the charms (and frustrations) of BASIC is instant feedback. Of course, the feedback is not always positive, but at lesst one doesn't heve to go through a compiling-like process to find out that the program doesn't work anyway. Although it may not be considered

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elegant programming, it's usually possible to debug simply by running the program and keeping an eye out for dereilments. By forcing a two-step editing process, BPT's EDIT program introduces some BASIC programming tradeoffs that will appeal to some, but by no means all, program-

There are a few important points that are not all that clear in the manual. For example, "EDIT asks for a filespec . . . which may include a filename extension." Change that to read, ". . . must include an .SRC extension." If you don't include the SRC extension, the NUMBER program will not be eble to find your file end num-

When you're finished editing, your options are New, Old, Run, or System. The first two permit more editing, Run can't be used yet (since you still heven't numbered the program), and System takes you back to DOS. To avoid this, just type R and specify e nonexistent file. This gets you e "file not found in 680" error, but at least you remain in BASIC and can run the NUMBER program.

As a final EDIT precaution, the manual suggests using the EDIT.HLP file to familiarize yourself with the edit commands. However, if you follow the directions, this

JE OF THE charms (and frustrations) of BASIC is instant feedback.

file becomes part of your program, and makes numbering and subsequent running impossible. It is probably simpler to use the quick reference chart on page 21 of the manuel instead.

Other Programming Tools

The next programming tool is UN-NUMBER, which simply unnumbers an ASCII file and creates an .SRC file, which may be edited and (re)numbered as described above.

SUPER LISTER (SL) does two things. First, it produces an enhanced program listing with indentations and spaces to make the program more readable. Second, it lists all the variable names in alphebetical order at the end of the program listing. To demonstrate the variable-name listlngs, SL was used with the sample program on SofTool's BASIC Development System disk, and the results are presented in Figure 8. (For comparison with Sof-

At the user's option, the SL listing may be directed to an output file, a printer, or the screen. If you choose the screen option, you'd better brush up on your speed reading, since the listing disappears almost as fast as it is displayed. To keep the screen listing long enough to study it, add the following line to the SL2.BAS pro-

Tool's X module, see Figure 4.1

2479 INPUT "Press eny key to continue.",KK

Or, change line 2480 to read 2480 IF LEFT\$ (LD\$) = "L" THEN PRINT CHR\$(12):

Finally, add the following line to keep the whole works from vanishing before you're finished.

2145 INPUT "Press any key to conclude.".KK

The final BASIC Programming Tool is the STRIP program; it deletes ASCII-file remarks beginning with a single quote (1). leaving only the single quote. Statements

Figure 8: BPT's SUPER LISTER program. SAMPLE 07-04-1983 12:44 *CROSS REFERENCES* VARIABLE REFERENCES (* INDICATES LINES WHERE CHANCED) A.STRING 130* ARRAY (): 80* 100* B.STRING\$. 50* DBL. PRECISION#: HEX. VALUE 40* 110 100 70 SNG. PRECISION: 60* YEAR: 140*

"LINE REFERENCES (* WHERE REFER-ENCED BY GOSUB) 150: 70 120

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beginning with REM are not affected. STRIP elso removes unnecessary blenks, after which the program is saved with an STP suffix.

Next, the .STP program is loaded. Simply hitting the Enter key will save it as a BASIC (non-ASCII) file and also kill the .STP file. Or, if you like, save them both.

I agree with the BPT manual that, "Perheps the most useful programming tool of eil is EDIT." If you like what it does, then BPT is well worth the money, and the other four programs simply come along as part of the deal. If you don't plan to use EDIT, there's not much point in having NUMBER and UNNUMBER. SUPER LIS-TER is okey, but it's a greet deal slower and not as complete as BDS's F and X modules, as the Figure 6 comparison shows. And if you really want e super listing, you may heve to do it yourself anyway. As Figure 9 illustrates, SL may not always be an improvement. In conclusion, STRIP is not nearly as thorough as BDS's COMPRESS module

Summing up. after a few days with Sof-Tool's BASIC Development System, I wonder how I ever got long withoul it. Being able to type L, C, or N, instead of LIST, CLS, or NEW may not qualify as one of the great breakthroughs of the computer

Summing up, after a few days with Sof Tool's BASIC Development System, I wonder how I ever got along without it.

age, but it's nice—very nice indeed. And so are the rest of the BDS goodies. This set of tools should be in everyone's software library.

While the BASIC Development System might fell under the heading, "instant gratification," BASIC Programming Tools is more of an acquired state. The EDIT program is its star effreact background, you'll SASIC from a Fascat background, you'll say the state of the stat

Once mastered, BFTs function key sasignments ere great for debugging chores, especially the Split and Join keys. It's also handy to be able to move lines into the copy buffer, and transport them to other locations within the program. Once agein though, you can do pretty much the same thing in regular BASIC by overstriking the line numbers.

For programmers at my level of experities (sub-basement, behind the oil burner), acquiring the BASIC Development System is a definite must, white the Bosic Programming Tools is a definite maybe. It is not likely that with experience the user will outgrow the BDS, but it is possible that with that experience, the capabilities of BPT's BDT program may become even more appreciated. How's that for a tight conclusion? PPC

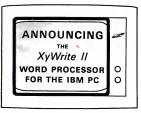


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Digital Research has developed some powerful additions to Pascal, along with most of the tools a programmer could ever want.

The Pascal/MT+86 System

Pascol/MT+86 Version 3.1 Speed Programming Package (SPP-88)

Version 3.0
Digital Research Incorporated
P.O. Box 579

Pacific Grove, CA 93950 (408) 649-3896 List Price: Pascal/MT+86, \$600; SPP-88.

Requires: 192K RAM, 2 disk drives preferred.

CIRCLE 695 ON READER SERVICE CARD

With the Pascal/MT+88 system, Digitage search inc.'s language division has put together all the tools needed by the Pascal programmer. A special Pascal screen editor, compiler, linker, assembler, debugger, disassembler, and a software librarian are included in the package. The only item not included in the price is the Pascal screen editor, a program that includes a syntax checker, variable identifier, text reformatter, and a backup/logger utility. I cannot think of much more a programmer would want. The \$800 price for the language and the screen editor might seem a bit steep, until you look at what you are getting: a quality package from a quality company you can rely on for support. This support is especially important for the independent software vendors creating all the new application packages everyone seems to be buying. An added advantage of DRI's Pascal is the portability of the source code. With few exceptions, you can take the source code developed on a CP/M-88 system and sell it for a PC-DOS system. Digital Research is even talking about creating a UNIX version of its Pascal and other languages, which would further increase the software vendors'

market. The beauty of the Pascal language, combined with the many programming tools available, and the large marketplace make the DRI package an irresistible development tool for software vendors.

Digital Research's Pescal is a full implementation of the ISO standard Pescal (ISO standard DPS/7185) with some powerful (and necessary) additions. There are four areas of additions: enhanced I/O capabilities, additional data types, access to the run-time system (access to CP/M and PC-DOS), and modules and overlays. The additions will be mentioned again as each language ingredient is examined.

Constants, Variables, and Data

Types
Pascal allows identifiers of any length
for constants, variables, types, procedures, functions, and program names, but
such distinguishes between them using

106

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Mul a washeet final industrial or differentiated Assess Machine Inc. (458) 77-646 (bit 47) fin 61 (bit 57) finds a templeted trademan of Digital Selection Inc. Autocoas (**Demonsus.) the first eight characters. The identifier can be any combination of letters, numbers, and underscores (.), as long as it starts with a letter. Both numeric and string literals can be used as constants. Unlike some versions of Pascal, this version allows the null string to be used. There are two kinds of deta types that can be defined: simple and structured. Characters, integers, long intagers, real, byte, word, pointers, end Boolean are examples of simple types. Another important simple type is the user-defined ordinel type, of which there are two kinds; enumerated and subranges. The enumerated ordinal type is used to defina a special data type, and lists all the possible values that typa can beve. The subranga type is used to select a range of values from a previously defined ordinal set. Exemples of both types are shown in Figure 1.

The structured deta type includes arrays, records, sets, strings, and files. The record types can be quite complex. They can include a CASE statament that changes the structure of the record, depending on the velue of a special case selector variable.

Operators and Expressions

The large group of operetors that used to construct the different expressions in Paccal MrI-80 are listed in Figure 2. There are operations for edition, subtractions for the control of t

operators that work only with Boolean operands. The logical operators work with individual bits in words and bytes. The last group of operators work with sets and allow you to compare different sats for equality, inequality, and subset stetus. Unions, Intersections, and set assignments are also possible.

Statements

There are eight major statements in the Pascal/MT+88 lenguege. The first is the simple assignment stetement, which sets a variable or literal to a certain value. The CASE statament executes different groups of statements, depending on whather tha case variable matches one of the enumerated case values. Pascal/MT+86 has added an ELSE to the CASE statement so that if the case varieble does not match any of the choices, you can still direct program flow. If you do not use the ELSE and there is no match, control fells to the next stetement below CASE. FOR ellows progrem loops using either the form FOR × := low TO bigh DO or FOR x := bigh DOWNTO low DO. The GOTO statement allows you to trensfer program control to a lebeled stetement. The IF-THEN-ELSE statements can be nested many layers deep to provide a very structured decision tree. Two statements allow for continuel execution of a group of statements until an exit condition is met. The REPEAT command executes the statements and then checks the exit condition so that it elweys executes at least once. The WHILE command checks the controlling condition first, and then executes the stetements if the controlling condition is TRUE. The lest stetement, WITH, makes it very eesy to access a record's subfields in a group of statements without having to use the full record _name.field_nama format.

Procedures and Functions

The many different procedures and functions already supplied with Pascal/MT+86, in addition to the ones you write are the basic units of eny Pascal program. Each procedure starts with the name of the which are pasced to the procedure, which are pasced to the procedure, which are pasced to the procedure by the Each function is defined similarly. Pascal/MT+86 supports functions and procedures that are esparately and mutually recursive. An interrupt procedure is also included in the separately and metally included in the and functions is seven in Figure 3.

A number of procedures have been added that are not in the ISO standard: bit manipulations, I/O port setting and checking, redirectable user I/O routines, fast file I/O, random file access, string manipulations, bean premote management, function addresses and sizes, and move and functions deserves special note. The IN.

LINE procedure allows you to insert an assambly language commend right in the middle of your Pexcal source program.

ALL PASCAL programs must be structured the same way.

Special error bandling is controlled by the GERR procedure. The GBDOSS8 function allows interfacing to the computer's operating system. The MAXCAVAIL end MEDMAVAIL functions return the largest MEDMAVAIL functions return the largest memory, respectively (regardless of fragmentetion) for program control of the memory structure. There are also many procedures and functions to bandle string manupulations. Trigometric calculations, odd and even number detection, file and to the control of the dispersal for an abstract and but testing and sections.

All Pascel programs must be structured the same way. The program name is first, followed by the different data type definitions. All literal, constant, and variable definitions are then listed. Any external

Figure 1: An example of the enumerated and subrange ordinal types.

TYPE STUDENTS = (FRESHMEN, SOPHOMORE, JUNIOR, SENIOR):
NAMES = (MARGENE, GEORGE, FRANCES, JACK, LINDA):
PETS = (DOG, CAT, BIRD, FISH, TARANTULA);

Enumerated Ordinal Type

TYPE NUMBERS = '\(\theta\)' . . '9'; INDEX = 1 . . 25; GOOD_PET = DOG . . FISH;

Subrange Ordinal Type



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Distributed by Programming International 505 Hamilton Avenue, Suite 301, Palo Alto, CA 94301 (800) 222-8811 inside California (415) 324-3730 Dealer inquiries, welcome. procedures or functions are listed next, followed by program procedures and functions. The main program section, which calls the different procedures, is

THERE
are various ways to
move information back
and forth from the
program to files and
peripheral devices.

the last item.

DRI has added some powerful options to its Pascal. The programmer can create several modules of procedures and functions and compile and file them separately, or keep tham in a module library (or keep tham in a module library (or hinking to other compile routines later. This modular strategy produces programs and that are easy to maintain and elst. in a case where insufficient RAM available for a large program, Pascal MT - 80 allows for large program, Pascal MT - 80 allows for the compile to the program of the

root program, and up to 255 overlays, can call other overlays, can occess procedures and functions in the root program, and may contain an arbitrary number of modules. The programmer has complete control of the overlay memory usage and location. A warning however: This capability adds responsibility and danger to the programmer's chores.

Another nice option is the ability to claim to other programs from the starting program. Procedures and modules writter in assembly languaga for those operations where execution time is very critical can also be used.

Input/Output

There are various ways to move information back and forth from the program to files and peripheral devices. The standard procedures and functions of Pascal/ MT+86 allow two different kinds of file I/O: sequential and random. With the ability to redirect the data with user-defined

Figure 2: A summory of Poscal/MT+ 86 operators.

Operator	Operation	Operands	Result	Precedence
		Arithmetic		
+	unary identity	integer or real	same ae	3rd highest
+	addition,	integer, real or pointer	same as	3rd highest
-	unary sign	integer or real	came ac	3rd higheet
-	subtraction,	integer or real	same as	3rd highest
•	multiplication	integer or real	integer	2nd highest
div	integer division	integer	integer	2nd highest
/	real divicion	integer or real	real	2nd highest
nod	modulus	integer	integer	2nd highest

Operator		Operand	Result	Precedence
		Relational		
=	equality	scalar, string		
		set, pointer		
		record	boolean	lowest
< >	inequality	scalar, string		
		eet, pointer		
		record	boolean	lowest
<	lese than	ecalar or		
>	greater than	etring	boolean	lowest
< =	lese or equal	scalar or		
		etring	boolean	lowest
	or			
	eet inclusion	set	boolean	lowest
> =	greater or	scalar or		
	equal	string	boolean	lowest
	or			
	eet inclusion	(666 4.4)	boolean	lowest
IN	eet membership	(sec 4.4)	boolean	lowest
		Boolean		
NOT	negation	boolean	boolean	highest
OR	diejunction	boolean	boolean	3rd highes
AND	conjunction	boolean	boolean	2nd highes
		Logical		
~ ?	one's comple-	integere and	same as	
or /	ment of operand	pointere	operand	highest
! or	logical OR	integers and	same as	
1		pointere	operand	3rd highes
&	logical AND	integers and	eane ae	
		pointers	operand	2nd highes
		Set		
+	union	set	set	3rd highes
-	set difference	set	eet	3rd highes
	intersection	set	set	3rd highes

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ORDER TOLL FREE: (800) 531-5475 (If outside of Texas) (512) 250-1489 (In Texas) 13010 Research Bird , Suite 101, Austin, TX 78750 I/O routines, the progremmer can creete his own type of file storege. The record data type should lead to routines that creete ISAM or keyed files without too much difficulty. The port functions ellow programs to control devices tied to certain port channels (physical devices) depending on the activity on other port chennels. When reading or writing to files. there is a file variable that contains two parts: a File Information Block (FIB) and e buffer. The FIB contains the file's name and type, whether the file is open for reading or writing, and the end-of-file and endof-line flags. The buffer contains one deta item et a time. You write end read from this buffer only; DRI calls it the window varieble. The manuel contains severel helpful examples of different types of file. keyboard, screen, and printer I/O rou-

SPP-86 Speed Programming Package

SETBIT

WRITEHEX

Now that we are familiar with Digital Research's Pascal. let's look et how to crete, run, and debug progrems. If you spend \$600 to buy the Pescal/MT+86, you might as well go shead and spand en edditional \$200 to buy the SPP-86 screen editor.

UNPACK

WRITELN

Although you can creete Pascal source code using e word processor, the word processor does not contain a syntax checker, variabla identifier checker, e Pascal

I LOATHE control and escape sequences, but these are not too had.

taxt reformatter, or a backup/logger utility. I found thas tools to be axtremely helpful in creating and editing Pascal programs. The full screen editor allows easy creation and updefing of programs. There are 26 different commands, which are crivated by pressing the Ctd key and another key (A through Z) simultaneously. I personally loethe control and escape sequences, but these are not too bad.

Once you have created a Pascal pro-

ted by pressing the Ctrl key and Compiling and Linking er key (A through Z) simultaneous-The next step after creeting e program

is to compile the Pescel program and assemble (using the ASMT-86 relocatable assembler) any assembly modules. The relocatable object files should have a file name. File. name. R86. The compiler has several options that allow you to choose which disks different files can be found on, or which disk to put them on. The options include: suppress unnecessary console messages; ganerate debugger in-

gram or updeted one using the editor, you

can use the syntax checker to make a sin-

gie pess through your program to check for

mispleced or missing semicolons or miss-

ing arguments from stetements. When the

syntax checker finds a mistake, it stops,

places you in the screen editor, and dis-

pleys the program end a message indicat-

ing where the mistake is for close to lt).

The Varcheck verieble identifier checker

scans the program and generates e list of

identifiers that are possibly misspelled or

undefined. After you have fixed any syn-

tax and identifier errors, you can cell the

reformatter to beeutify your program. It

indents all nested statements, producing a

more readeble source listing. The last util-

ity provided by SPP-86 is an automatic

backup/logger utility, which creetes e

backup file of your source every time you

enter the editor and change the original.

The utility will elso increment e version

number contained in perenthesis located

et the beginning of the program.

tion; and continue on error. You should now have two relocatable object files. The next step is to link the Pascal object code and the assembler object code with any run-time library routines and overlays that are needed by the Pascal program. Only the routines needed by the program are taken from the library and linked. The linker command elso has some options that control the amount of memory and locations assigned to the code and dete sections of the program and overlays. You can elso determine how the linker output will look. After linking, you should heve e runeble program that has e file name like this: file name.CMD.

formation; generate disessembler informa-

Libraria	
	Libraria

The LIB/MT+86 librarian lets you creete different general purpose modules and store them together in speciel libraries

	F	JNCTIONS	
@BD0S	@BD0S86	@CMD	@HERR
@MRK	@RLS	ABS	ADDR
ARCTAN	CHR	CONCAT	COPY
COS	EOF	EOLN	EXP
GNB	HI	IORESUL'	LENGTH
LN	LO	MAXAVAIL	MEMAVAIL
ODD	ORD	POS	PRED
RIM85	ROUND	SHL	SHR
SIN	SIZEOF	SQR	SQRT
SUCC	SWAP	TRUNC	TSTBIT
WNB			
	PRI	OCEDURES	
@ ERR	@HLT	ASSIGN	CHAIN
CLOSE	CLOSEDEL	CLRBIT	DELETE
DISPOSE	EXIT	FILLCHAR	GET
INLINE	INSERT	LWRITEHEX	MOVE
OVELEFT	MOVERIGHT	NEW	OPEN
PACK	PAGE	PURGE	PUT
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that can leter link to other mein programs. You might, for exemple, went to create several printer I/O routines or RS-232 modules, which can be used over and over again by many programs. The compiled modules must be relocateble object code files to be entered into e library. You can concetenete other libraries, essembly modules, and Pascal modules into one

Debugging and Disassembling The debugger is included to help find

any logic mistakes that might be present in your routines. There ere severel helpful features of the debugger that eid in testing the software. The debugger can do the following: displey variables in many formats; modify memory; set reguler or symbollc breakpoints: single-step through the program; displey symbol tables; end display entry and exit points for procedures

end functions.

To use the debugger, a special flag must be set in the compiler when compiling the program to be debugged. The linker command parameters are elso different when linking a program to be debugged. The disassembler is useful for e progremmer wenting to see how a Pascel program was converted into the 8086 essembler lenguage. Both the disassembled essembly lenguege instructions end the Pascel stetements are shown in blocks so that the progremmer can follow the logic of each sec-

Manual

The Pascal manual comes in the nowfemilier ten enclosures similar to the ones in which IBM distributes its softwere. The documentation is divided into three sections: the Languege Reference Menuel, the Language Programmer's Guide, end the

Function key F8 BFUNCTION 00

Function key F9 CHELP\#D\#6

Function key F16 DDSKRESET

ASMT+86 Relocating Assembler Refer ence Manuel. The first section gives a brief overview of how Pascal is structured and the features of DRI's Pascal. It explains env differences between this version and the ISO version. Most of the section is taken up with e description of all the functions and procedures provided with Pascal/MT+86. All the dete types end statements are described and many include examples. The lest chapter in the first section gives e good explanation of the different types of input and output aveileble.

The second section gives detailed instructions ebout bow to compile, link, debug, disessemble, create libraries, and also includes other importent fects e progremmer needs to know. This section explains error messeges and describes how to creete overleys and modules, how to chein progrems together, bow to interfece with assembly lenguege routines, how to interfece with the operating system, how to create ROM-based programs. The last section expleins how to use the relocating assembler end whet different

conventions it will eccept. Overall, the manuel has a professional appearence. DRI uses different colors to emphasize points end list exemples. The table of contents and index are deteiled for easy reference. I heve only two comments ebout the menual. It could have included more exemples, especially with some of the function and procedure descriptions. And, the beginning programmer would probably find the manual too technical. Of course. DRI's main customer is not the beginning programmer, but the independent software vendor. I found the same feults in DRI's Concurrent CP/M-86 manuel. The company's PL/I menuel, however, is much better.

I found that both the Pescal/MT+86 end the SPP-86 worked well, end that any major problems with the system were the result of my own errors. The SPP-86 works nicely in creeting Pescal source. The rest of the programming tools (compiler, linker, disassembler, debugger, and librarian) ell worked as described in the menuel.

With such a large following just beginning for Pescal, DRI should find its peckage being used more end more in vendors' software. With the tools there to creete powerful, versatile modular programs, the Pascal/MT+86 and SPP-88 team is bard to beet. DRI hes egain provided e professional, complete package.

SPP-86 Function Key Programming

An alternative to using the control sequence commands with the screen editor.

\@D\@@

With the SPP-38 Pascal Speed Programming Package, an understanding of 26 different Ctrl/letter sequences is required to use the screen editor. Even though these control sequence commands can be mastered with practice. I came up with an easier way. Although the manual does not mention it, you can use CP/M's function command or one of the many PC-DOS function key utilities to set up the ten most commonly used editor commands. For instance, in the screen editor configuration, you cannot use the arrow keys. home, delete, etc., but using the function key utilities enables you to set up those special keys to produce the needed control sequences

I set up the different direction keys to work with SPP-86's screen editor to produce a much easier working environment..

Function key Fl : SDIR\ØD\ØØ Function key F2 <SDIR \ØØ =STAT * . *\#D\## Function key F3 Function key F4 >STAT \ØØ **Function key F5** PYCMODE D\ØD\ØØ @VCMODE B\@D\@@ Function key F6 Function key F7 ADSKMAINT\ØD\ØØ one in the free software domain .- G.D.H.

G\14\00 home key H\ØB\ØØ up arrow I\03\00 page up K\Ø8\ØØ left arrow M\ØC\ØØ right arrow 0\\$2\\$\$ end key P\ØA\ØØ down arrow 0\12\00 page down R\06\00 ins key S\19\ØØ del key

I did not use the regular ten function keys for the SPP-86 commands, although they could have been used, if desired. Then 20 out of the 28 control sequence commands would be reduced to a single keystroke. The \\$D is a carriage return (in hex) and "V66" is the hex character telling the function utility where the end of the definition is. This same function key arrangement can be implemented in Concurrent CP/M-86 using the same Function command. If you have PC-DOS, you will either have to buy a function key handler utility, or find



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Linkers can span operating systems, mix programming languages, conserve memory, and more—putting an end to your programming gripes.

The Missing Linker

There you are, joyfully banging out lines of BASIC, when your arms fell to your sides and en eerie sense of ill-being comes over you. The lines you just typed look strangely familiar.

> 510 IF ERR=70 then print "disk is write protec-

520 IF ERR=71 then print

"drive error" 530 IF ERR=72 then print

"disk error" Somewhere, you have written these lines before. Yes, it was in version 7 of your checkbook program, the one you did last week! Since you hate to type, you pull out your conv of CHKBK07.BAS, and conv 45 lines of the program into your new opus. Petting yourself on the back with your left hand, you save the new program with your right, only to be informed by DOS that you are out of disk space: Go directly to jail, do not pass go, do not collect \$200. This revolting development causes you to enter a long period of reflection about the state of the world, leading to some weighty philosophical questions.

• Why can't there be just one copy of each of the routines that you use all the time the ones to clear the screen, check for errors, draw nice boxes on the screen instead of heving to include the routines in every program that needs them end thereby run out of disk space?

■ Why can't you give each routine e name and refer to it just by that name? Then every time you wanted your progrem to draw a box you could just write BOX, and the program would find the routine called box and use it. You can do that in Pascal and C. Why not in BASIC?

You have been led to believe that BASIC, Pascal, COBOL, FORTRAN, and C compilers produce code for the 8086/ 8088. If all these langueges boil down to the same thing in the end, then why can't you use BASIC routines when you're writing in Fascal, or FORTRAN routines when you're writing in COBOL?

 And what if you want to switch from PC-DOS to CP/M-86 or vice versa? Why should you have to rewrite all the routines you used under the other operating system? It's the same PC, after all. One last gripe. You'd love to use the RAM disk that eats up 2586 of your computer's memory, but you only have another 64K, and ell your programs need of least 128K after they're compiled. Isn't there some wey to make the programs require less memory so that you can use your RAM disk without trading in your Sundey clothes for another 256K?

A LINKAGE editor is a program that performs a function similar to that of an assembly-line robot.

Relief is bere with a program called LDK, which comes with PC-DOS. This program, and programs like it, are called "linkage editors." A linkage editor is of program that performs a function similar to that of an essembly-line roots, pulling the right parts out of the appropriete bins, and assembling them eccording to the instructions given. Let's consider our questions and complaints one by one, and see bow a linkage editor can help.

The Copy Problem

Suppose you compile the following Pascal program, and get an OBJ file called HELLO.OBJ.

module hi;

procedure hello; begin writeln('Hello') end;

end.

Sometime later, you write a program

called GLADHAND.

program gladhand;
procedure hello; external;

begin hello hello hello hello end.

When this is compiled into GLAD-HAND.OBL you are ready to use the link-

ege editor. If you type: LINK gladhand hello;

the linkage editor will search through GLADHAND.0BJ, and note that there are four references to the routine called HEL-LO. For the first reference, it will copy the code from HELLO.0BJ into GLAD-HAND.EXE. For all the other references, it will simply call this code rather than insert a redundant copy.

There are still two copies of the routine RELIAC: one in HELIACOB, and one in GLADHAND.OB, But there is one important difference. HELIA is compiled only once, and forever after, the compiled only is transferred into programs the need it, rather than having to be recompiled each time. This technique is faster. If you've ever waited for a compiler to finish, you'll appreciate the improvement.

The Naming Problem

The example above shows bow a named routine in Pascal can be linked. The same can be done in BASIC by keeping each routine in e separate OBJ file, which can get unwieldy if you have a few bundred BASIC routines that you use

After the compiler turns o program into object code, it is combined with librory routines to become o complete, executoble program.

Libraty(s)
Source code >>> Compiler >> Object file(s) (OBJ) >>> Linker >> EXE

BASLIB.LIB

MYPROG.BAS >> BASCOM >> MYPROG.OBJ >>>>LINK >> MYPROG.EXE
OBJ file OBJ file OBJ file

library manager

library file (LIB) often, each in a separate file.

To avoid this problem of OB, file proliferation, linkepe editors can elso combine code into LiB, or library, files. A LiB file is created by combining OB, files, or library may be created from bundreds of separate OB, files. There is a special utility to do this combining, which is appropriately called a "library manager." Combining the OB files with a library manager allows you to put all your routines into a single file.

The library manager also allows you to delit libraries; you can extract replace, or delete any routine in a library. Some library managers (PLIB-86, from Poennix Software Associates, for example) will also generate lists of whet routines are in the library, what other library routines they use, and all symbols defined in the library. This feature is very useful in dissecting libraries that have no source code.

FORTRANLIB. COLIBLIB. BA-BLB IB. and PAGCALLIB are collections of routines that do all the common tasks a program might require. The compiler translates source language statements into references to the library routines, and the linker then copies in those library routines that have been referenced. This is why LMK is included with PC-DOS. Without it, you would not be able to use any of the language compiler.

THE LINKER doesn't care if the pieces were originally written in Pascal, BASIC, C,

FORTRAN, or assembler; it will combine them all together.

The Language Problem

Since the linkage editor links OBJ files, it doesn't matter how those OBJ files were produced. (Some exceptions will be discussed later.) The linker doesn't care if the



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pieces were originally written in Pascal, BASIC, C, FORTRAN, or assembler; it will combine tham all together. This fact has some interesting implications.

HE LINKER makes it possible to write sections of your programs in different languages.

Although it is certainly possible to do anything in any programming lenguege, you may oot always be able to do it as quickly or simply es you could if you used the "appropriata" language. If speed of execution is critical, you would probably want to use assembly language. BASIC lends itself to iotensive debuggiog with the interpreter. Pascal is appropriate for very large programs.

The linker makes it possible to write sections of a program in different languages. You may, for example, have to do extensive number crunching in a large program, for which you oeed the speed of assembly languege. But it would be time coosuming to write the whole program in assembly language. The solution is to write the meth routioes in assembler and the rest of the program in Pascal, and link them together. Many commercial programs cootain sections of time-critical code, which were written in assembly language, while the bulk of the programs were dooe in a higher level language.

Suppose you had a program consisting of three parts-a part written in FOR-TRAN (fpart), a part written io Pascal (ppart), and a part writteo io assembly language (apart). After compiling each part with the eppropriate language compiler, and getting three OBJ files, you could use LINK to put them together like this:

link fpart ppart apart. program, fortram.lib pascal.lib

You are giving LINK three instructions: Combine fpart, ppart, and apart into a program called "program"; refraio from geoerating a listing file (indicated by the two commas with nothing between them); and, if there are routines that are oot defined to any of the three OBI files, look for them in the files FORTRAN.LIB eod

PASCAL LIB. You must be aware of one thing before you try to link different languages together: Their data must be represented in the same way, if the languages are to share it. Microsoft/IBM Pascal and FORTRAN, for example, use a common definition for most types of data, but there is oothing corresponding to the Pascal STRING in FORTRAN, and nothing corresponding to the FORTRAN INTEGER*4 in Pascal. Either these incompatible types of data

Product Information (And Explanation)

A summary of the linkers and librarians mentioned in the article.

PC-DOS IBM Corporation

Systems Product Division P.O. Box 1328

Boca Raton, FL 33432 (305) 998-2000 List Price: \$40

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LINK runs under PC-DOS or MS-DOS, and is included with the operating system. LINK connects OBI files generated by any of the Microsoft or IBM compilers, producing EXE files. The Microsoft OBJ format is a slight modification of Intel's original OBJ format, made to speed library searches. Thus, LINK cannot handle ell intel or CP/M-86 compilers' output files. LINK does not geoerate overlays.

LINK-86

Digital Research, Inc. 160 Central Ave. Pacific Grove, CA 93950 (408) 649-3896

List Price: \$250 CIRCLE 692 ON READER SERVICE CARD

LINK-86, is locluded with all Digitel Research language compilers, or is available separately, with LIB and a relocating assembler. Functionally, it is the same as the LINK-80 for CP/M-80. LINK-86 runs under CP/M-86, and was recently anoounced to run under PC-DOS. It links Intel-format OBI files produced by the Digital Research language compilers ter documentation then LINK or LINK-(CBASIC-86, Pascal MT/86, PL-1/86, and 86.

COBOL), and the related tools (access manager, display manager). The CP/M-86 version produces CMD files, which run under CP/M-86, and the PC-DOS versioo produces EXE files, which run under PC-DOS. It will link some, but not all, Microsoft or IBM OBJ files, and it supports overlays. The library manager LIB is included with LINK-86.

PLINK-86. (available to run under PC-DOS or CP/M-86)

Phoenix Software Associates P.O. Box 207

North Easton, MA (617) 238-0168

CIRCLE 691 ON READER SERVICE CARD

Lifeboat Associates 1651 Third Ave. New York NY 10028

(212) 860-0300 List Price: \$350 each, or \$500 for both.

CIRCLE 690 ON READER SERVICE CARD

PLINK-86 comes in two versions, one that runs under PC-DOS and one that runs under CP/M-86. In either case, the program helps bridge the gap between the two operating systems. Both versions link Microsoft-format OBJ files to produce both "EXE" files for PC- MS-DOS, end CMD files for CP/M-86. Both handle overlays. There is support for PC- MS-DOS 2.0 path names, as well as ao extensiva set of diegnostic and reporting facilities. lo addition, this linker is significantly faster thao LINK, includes a library manager and cross-reference facility, and provides bet--M.O.



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Figure 1: In overlaying, one block of memory is shored by two or more parts of the program

Contents of memory

Part two Part three

Part one

When characters are printed

When music Is being played

Part three Part two Pert one

must not be shared, or the program pieces must be written to account for the incompatibilities.

make it possible to shift between languages and operating systems without starting from scratch.

Individuals and large organizations are the same in one respect: Once they devote time and money to writing and debugging software, they don't like to throw it away and start over. Linkers make it possible to shift between languages and operating systems without starting from scratch. Large FORTRAN programs on mainframe

computers can be linked with Pascal programs. And, if you decide that you'd like to switch to programming in C, there's no need to rewrite all of your finely crafted assembly language routines, just link them in

Extending the Language You want to add a new command to

your BASIC? Okay, just write the routine and edd it to BASLIB.LIB. Then you can use it in your program as if it were a huiltin BASIC command. The linker will copy the code from BASLIB.LIB when the program is compiled.

Although it can be tricky, you may also replace any of the routines in BASLIB.LIB with your own routines. You must be sure. bowever, that your routine does exactly what the original one did, and that it leaves the environment exactly the same. It is through this method that some companies have added 8087 arithmetic chip support to standard Microsoft BASIC and Pascal; they replece the software math routines in BASLIB.LIB and PASCAL,LIB with routines that use the hardware math capabilities of the 8087.

The same set of routines can, with the right linker, be used in either CP/M-86 programs or PC-DOS programs, with no

modification This convenience is largely due to the influence of intel as the manufacturer of the 8086/8088. When the chip was first released, Intel defined an OBJ format for its compilers, which was taken as a model by both Microsoft and Digital Research. Digital Research adopted the Intel OBJ for-

mat in its entirety.

SNEW operating systems like VisiOn, Xenix, and Pick move onto the PC. linkers will move with them.

However, Microsoft mede some minor changes to the Intel OBJ format to speed library searches. Provided e library doesn't have to be searched, the Digital Research/Intel and the Microsoft/IBM formats are compatible. Unfortunately, any lenguage, except assembly language, will require that a library be searched! This

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translates into the following facts.

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may be linked together.

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The OBJ files produced by MASM may be linked with any of the OBJ files produced by any Digital Research len-

guages.

The OBJ files produced by the Microsoft/IBM languages (except for MASM)
may not be linked with the OBJ files produced by the Digital Research languages.
This is true whether the Digital Research
languages are running under CP/M-86 or
PC-DOS.

Bridging the Gaps

There is a linker that will partly bridge this operating system gap. PLINK-86 from Pboenix Software Associetes will allow you to generate, from any Microsoft/IBM format OBJ files, both e CMD file for CP/ M-86 and an EXE file for PS-DOS. It does not solve the problem of the incompetible

NEW! financial fas

OB] formats (et least not in the current version), since it cannot handle the OBJ output of the Digitel Research compilers, but it does ellow you to span operating systems without chenging your routines.

A linkage editor can even help you reduce the amount of memory required for your programs to run. This can give you plenty of extra memory for RAM disks, print spoolers, or other uses.

The method used for seving memory is known as overleying, e feature not found in IBM/Microsoft LiNK, but eveileble in the Digital Research and Phoenix products. If you use WordStor of Bose II, you are alreedy femilier with program overlaying, which both of these populer products use to conserve memory.

Overlaying is the sharing of one block of memory by two or more parts of e program. Suppose you have a program with three parts (see Figure 1). Part one gets characters from the keyboard. Part two pleys the characters es music. Part three puts them on the screen. Part three end part two both need part one to get the characters.

ecters for them, so part one alweys has to be in memory. But part three is independent of part two, and vice versa. Both don't heve to be in memory et the same time. You could put part two in memory, and, when the task it was performing was completed, replece it with part three. When part three was done, you could replece it with part two, and so forth.

IF YOU USE only the BASIC interpreter, you are unlikely to ever need a linker.

An overleying linker generates a program thet will keep track of which parts of itself are in which parts of memory, and automatically replece those parts that are not needed, filling the vecated spece with parts of the program that are needed. This allows very lerge programs to run in limited memory spece. Programs as large as 2 megabytes can run on a computer with only 48K RAM. (Of course, the swepping slows things down, but not appreciably on e hard disk.) Some very large programs, which otherwise would not fit on your PC, can fit very easily with overlaying. Others thet would fit can be overleyed in order to free memory for other uses.

With so many edventeges, is there eny reson not to use a linker? Certainly, if you use only the BASIC interpreter, you are multilely to even need e linker. But asyone who uses a compiler, wishes to build so make you will be to make you will be to make you will be to make you will be you will not you wil

VisiOn, Xenix, and Pick move onto PC, linkers will move with them, so t	th
you will never egain have to write:	
510 IF ERR=70 then print	
"disk is write protect	c-
ted"	
520 IF ERR=71 then print	
"drive error"	
530 IF ERR=72 then print	
"disk error"	F

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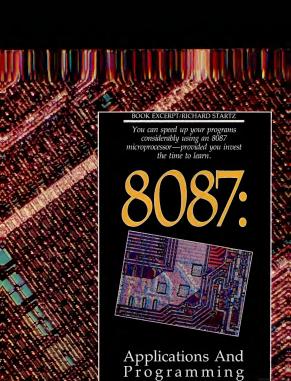
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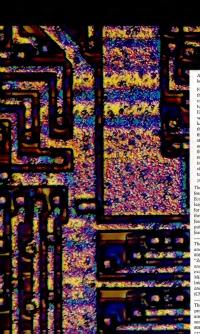
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August, 1983. Brady describes the

book this way: For novice and potential chip users, the text includes a nantechnical overview of the capabilities of the 8087, featuring speed benchmaking and guidelines for buying compatible 8087 software. For program writers who want to know intimate details about the chip. the text includes a complete section of the 8087 instructions, with special attention to linking assembly language and basic programs. For program users, the text includes a wide variety of ready-to-use "cookbook" applications, including the "8087 Statistical Analysis Program." There will be a diskette to accompany the book including all programs from the text.

The author, Richard Startz, assistant professor of finance at the Whartan School of Economics in Philadelphia, has used large camputers far many years as a tool far professional research. He claims that the 8087 makes his personal camputer fost enough for large scale numerical camputing. And, he adds. 'The 8087 isn't just fast: it's very easy to use.''

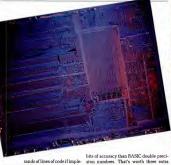
The following introductory information and the accompanying sidebars ("The 8087: An Add-On Device for the PC." "Zen and the Art of 8087: Installation." "and "Pattern Incampatibility" have been excepted from "Introduction—Turning Minutes (Into Seconds" (Chapter 1), "The Intel 8087 Chip" (Chapter 3), and "Bujting and Building 8087-Campatible Software" (Chapter 3).

The brain of any computer is its central processing unit (CPU). For the IBM PC, and many other "second generation" personal computers, the brain is an Intel 8088. A complete, general purpose central processing unit built by a principle of the computer of





Mondrian in Silicon: The photo below is on entire 8087 chip. All the surrounding photo ore blowups of one portion or onother of the 8087. The metallization and transistor interconnections form patterns pleasing to the eye. The microphotographic techniques used here enhance the appearance of the chip (actually silvery gray) with colors generated by texture differences on the surface.



mented in software. The 8087 hardware can operate 10 to 200 times faster than equivalent software. (See Sidebar, "The 8087: An Add-On Device for the PC.")

But the single most important attribute of 8087 is its remarkable accuracy. After all, easily-written, fast-executing programs are no great trick-if you don't care about getting the right answer. The 8087 has three accuracy-enhancing features.

Internal calculations yield 11 more

decimal places.

• Internal calculations have an extremely wide range. The 8087 can represent numbers as large as 104932 and as small as 10-4932. As a result, calculations rarely overflow or underflow during intermediate steps. In fact, both the precision and range of numbers are greater than those found on most traditional mainframe computers.

• The 8087 is designed to handle a



wide range of error conditions and make an eutometic and graceful recovery. As e result, simple "peper and pencil" elgorithms are much more likely to work. And when something goes wrong, the 8087 follows well-behaved rules instead of producing the wrong answer.

THE 8087equipped personal computer is the first micro to compete economically with its larger cousins.

How Fast Is Fast?

Just how fast is an 8087-equipped PC?
A good comparison can be mede to either
e standard mainframe computer or to e
microcomputer without an 8087.

Petheps the most remarkable stetement to be mede about the 8087 is that it ectually makes sense to compare its speed to that of a mainframe computer costing hundreds of thousands of dollars. The 8087 is several times slower than a half million dollar machine—but then it's more than several times cheaper.

Exact comparisons are always risky, but a few numbers can give you selevation for the speed of the 8097. Modestee speed institutes of the 8097 of the

For the very first time, e microcomputer is e cost-effective alternetive to number crunching on lerge computers. The PC with 8087 is ¼ to ½s the speed of a large computer at ½s to ½s of the large mechine's cost. While large mechines will always be more cost-effective than micros for some tasks, the 8087-equipped person.

el computer is the first micro to compete economicelly with its larger cousins.

Most PC owners care more about how the 8087 will speed up their personal computing than about comparisons to large centrel computer facilities. The speed edvantage of edding an 8087 to a PC depends on the epplication and on how you use the 8087. The centrel point to understend is that the 8087 is a Numeric Dato Processor. The 8087 only speeds up programs involving numerical computetion. If you only use the PC for word processing, the 8087 is about 99 percent irrelevent. But if you crunch the occasionel number, edding an 8087 is like trading e sparkler for the Fourth of July fireworks displey.

The speed edvantege of the 8087 depends very much on how you use it, but as e good overall guide: The 8087 turns minutes into seconds.

Just how much you get out of en 8087 depends on the software you use se well es the 8087's hardware speed. What the 8088' will do for you depends on how much time your software spends on various "overheed" tasks versus how much time is spent in numerical calculations. The



8087 Applications and Programming for your IBM PC and other PCs Richard Startz

(Robert J. Bredy Co., Bowle, MD, 1983) 250 peges, \$19.95 CIRCLE 667 ON READER SERVICE CARD 8087 speeds up the numerical calculctions but does little or nothing ebout the time spent on overhead. Figure 1 shows whet kind of results you can expect when you combine the 8087 with low-overheed, high-speed routines.

The times in Figure 1 compare (pre-8087) BASIC to special 8087 routines. The improvement is typical of what the combinetion of the 8087 and good software can do. Depending on the application, the 8087 hardwere produces an improvement in speed by e fector of ebout 10 to 50-the rest is due to the low-overhead software. You won't see nearly as good an improvement if you use the 8087 with high-overhead software. (The BASIC interpreters built into e computer are, of necessity, high-overheed software.) Since the 8087 only speeds up numerical calculations, and such software spends reletively little time on numerical calculation, the sum of overheed time end numerical calculetion time won't fell by nearly the emount shown in the table ebove. The improvement will be impressive, nonetheless,

Three basics determine an actual program's speed: the wey you solve the problem (what computer scientists call the "algorithm"); your hard ware's speed; and the behavior of the programming language trensletor. The first is elweys the most importent. There is no computer so fest that it cannot be slowed to e crawl by e sufficiently bad wey to solve e problem.

The following text is token from "Introduction to 8087 Architecture" (Chopter 5).

How the Co-processor Works The 8087 is designed as a co-processor

for the 8088 CPU. Both the 8087 end 8088 "look" et eech instruction fetched from memory. The 8087 ects on its own instructions and ignores those belonging to the 8088. When the 8088 sees an 8087 instruction, which is en 8088 ESCepe instruction, it celculetes the eddress of any dete referenced by the instruction end reeds-but ignores-one byte of dete from this eddress. Otherwise, the 8088 treats the 8087 instruction as a null operetion. The 8087 copies the eddress calculeted by the 8088 and uses it to store or fetch dete to and from memory. In this way, the co-processor design ellows the 8087 and the 8088 to execute simultaneously, considerably enhancing total

system performance.

Figure 1. Time in seconds when 8087 is combined with high-speed routines.

Program	50 by 50 motrix multiplication	5,000 squore roots	
BASIC	1200	52	
8087 routine	8	0.35	

Figure 2: Statistics on seven regular 8087 data types.

Dato Type	Bits	Significont Digits	Ronge
Word Integer	16	4	-32,768 to 32,767
(BASIC integer)	32	9	-2×109 to 2×109
Short Integer			
Long Integer	64	18	-9×1018 to 9×1018
Pecked decimal	80	18	18 decimel digits +
			sign
Short Real	32	6 or 7	10 ⁻³⁷ to 10 ³⁸
(BASIC Single	64	15 or 16	10 ⁻³⁰⁷ to 10 ³⁰⁸
Precision)			
Long Real			
(BASiC Double	80	19	10 ⁻⁴⁹³² to 10 ⁴⁹³²
Precision)			
Temporary reel			

Synchronization is achieved through judicious use of the 8088 Wait instruction. The Wait instruction tells the 8088 to us, pend processing until the Test line becomes active, (The 8088 checks the Test line stetus once every microsecond.) When the 8087 begins an instruction, it sets the Test line to inactive, it then resets the Test line to active when the instruction is complete.

Internal 8087 Registers

Five internel data areas are accessible by the 8087 programmer. These are the register stock, the stotus word, the control word, the tog word, end the exception pointers.

8087 computation is organized around eight 80-hit data registers. These registers form a pushdown stack, called the register stock. The register at the top of the stack is referred to es ST or ST(9); the register immediately below the top is ST(1); and so forth through ST(7). Meny 8087 instructions implicitly reference ST(10) or both ST(0) and ST(1). Many instructions also push deta onto or pop data off of the stack. (The steck is actually organized as a chein, so that ST(0) is "below" ST(7). It is the programmer's responsibility to prevent stack overflow.)

The 16-bit stotus word shows the current stete of 8007 operations. We make extensive use of the condition code his the status word, which indicate the site of 8007 comparison operations. The status word, which indicate the sword isos shows whether any exceptions word isos shows whether any exceptions whether the 8007 in lawy, whether the 8007 has requested to interrupt the 6008, and which of the 8 stack registers is currently the top of the stack. These elements are primarily used for systems programming.

The 16-hit control word allows a number of 8087 options, described below under "control options," to be set under program control. These include the exception and interrupt-enable masks, which are primarily of interest to systems programmers. Other options, defining rounding, infinity, and precision controls, are occasionally used to control the results of numerical operations. Figure 2 shows the layout of the control word.

The tog word hes 2 bits for each stack register to indicate whether the contents of the register are valid, zero, special, or empty. The exception pointers show the current instruction end operand. Neither the tag word nor exception pointers are normally of any interest to application programmers.

Control Options

By manipulating the control word, you can change the way the 8087 handles rounding, infinity, and precision.

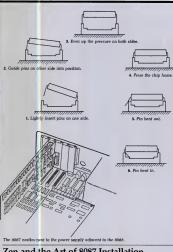
The 8087 offers four methods of rounding off answers that cannot be represented exactly in the availeble number of hits. The options are round to necrest, round down (toward minus infinity), round up (toward infinity), and chop (truncate toward zero). Round to necrest is the default.

The 8087, unlike most computers, has a well-defined representation of infinity. The 8087 produces the proper result when calculating mathematical functions with infinite arguments, at least when a mathematical law will be a support of the support

F YOU crunch the occasional

number, adding an 8087 is like trading a sparkler for the Fourth of July fireworks display.

Two modes of "infinity control" are offered on the 8087: offine closure and projective closure. Under affine closure, positive and negative infinity are regarded as being at opposite "ends" of the number line. Under projective closure, positive and negative infinity are considered equal, as if the two "ends" of the number



Zen and the Art of 8087 Installation

Take these astral steps toward raising the consciousness of your PC's mind.

Installing an 8087 in your PC need not be a traumatic experience. Granted, you paid a lot of money and got something that looks like an unimeginative mechanical rendition of a centipede. You want to do right by it and your PC, and by no means do you went to render either inoperative.

The Proper Frame of Mind Relax. Having turned off the power, remove the cover from your machine et a leisurely pace. Consult the Guide to Operotions. Use e 1/4-inch nut driver instead of e screwdriver for true peace of mind. Gaze upon the PC's system board end contemplete the wonders of Intel's wisdom. The empty socket next to the 8088 is the Yin and the 8087 you heve just purchesed is the Yeng. They belong together. Once you sense the rightness

of their joining, there cen be no reeson

to keep them apart. There are 40 pins on the 8087, harmoniously arranged into two rows of 20. They are, no doubt, embreced by e piece of conductive foam that protects the soul of the chip from the negative vibretions of stetic electricity. There are 40 contacts in the socket, each yearning to merge with its companion pin. Arrenge yourself before your PC, plecing an arm or hend on the metel chassis. Experience the joy of liberating your body from its cure of static charges. Contemplete the "I" on the 8088 end note that there is e matching "I" on the 8087. Destiny is calling them together. Orient them so that they fece the same way and you will discover that the notch on the end of the 8087 respectfully feces to the rear of the mechine, as do

those of ell other chips on the system

It Happens Through You

board.

Remove the protective foam from the pins of the 8087, taking care not to disturb their harmonious relationship through bending. Plece the row of pins closest to the 8088 into the socket, holding the body of the chip at a small angle. Seat the pins lightly, making sure that all are in place. Then, focus the ki energy through your fingertips end apply e light sideways pressure to the right, guiding the pins on the left side gently into the contacts. Your eyes, guided by e deep-seated reverence for the money you parted with for the 8087, will search diligently for any pins thet ere misaligned. Finding none-all is in balance-press the 8087 into the socket with your thumbs. The gods will smile on your efforts. Your PC will be able to share your joy only if you move position 2 of Switch 1 to the OFF setting.

Experience the Fullness

Sit back; allow the essence of 80-bit floeting-point arithmetic to permeate your being. Feel the fluid ease with which you replece the cover, reversing the removel procedure. As you direct power into your PC, you and it will experience higher planes of consciousness and-with the proper softwere-true satori.

-Bill Machrone

line bent around and came together. Relative comparisons between finite numbers and infinity are permitted under affine closure, but not under projective closure. Projective closure is the default.

HE EXACT hit natterns used are laid out for the commuter's convenience and so are a little less than obvious to

Precision on the 8087 can be set to 64. 53, or 24 bits of accuracy, corresponding to the temporary real, double precision, and single precision data types. This option is offered so that the 8087 may comply with certain industry standards which offer only reduced accuracy and so that 8087 computation can be made compatible with less accurate computers. Aside from the compatibility issue, the only value in using less than the full 64 bits of accuracy is the educational value of

humans.

learning that more accuracy is better. Default precision is 64 bits. Floating Point Numbers

The 8087 "understands" floating point, integer, and packed decimal numbers. For number crunching, floating point numbers are by far the most important. In order to accommodate a wide range of values, computers store numbers in a "floating point" or "real" representation. Essentially, floating point is the computer's version of scientific notation. For example, in standard scientific notation the fraction "negative one-half" can be written out as

 -5.0×10^{-1}

Scientific notation splits the representation of a number into three sections. The "sign field" tells us the sign of the number, in the case above the leading "-" Indicates a negative number. Next, the "significand field." 5.0 above, gives the number's significant digita. (The significand field is also called the "mantissa."

The third section is the "exponent" field. The "-1" above tells us to multiply the significand by ten to the minus one power. or, equivelently, to shift the decimal point

one place to the left. The 8087 stores floating point numbers in a form of scientific notation. The exact

bit natterns used are laid out for the computer's convenience and so are a little less than obvious to humans. Fortunately, we almost never need concern ourselves with such minute detail. While exact bit patterns are covered below, there are really three facts to know about each data type:

1. How many bytes of memory are used up to store a number?

2. How many digits of accuracy are retained in a number? 3. How wide is the range of numbers

which can be represented; l.e., how large an exponent can be used? The answers to 1 through 3 are shown

in Figure 2.

Data Types

The seven regular 8087 data types are shown in Figure 2. A brief discussion of the use of each type appears below.

Short real. Short real corresponds to BASIC's single precision dete type. Micros heve less storage than mainframe computers. Since real world data rarely has more than six or seven digits of accuracy, this data type is commonly used for economical storage of basic input data. Long real. Long real corresponds to BASIC's double precision data type. As a rule, most calculations should be done in double precision in order to minimize the effect of round-off error in intermediate steps.

Temporary real. Whatever the data type in memory, the 8087 converts all numbers to the temporary real formet for internal use. The significend of the temporary real format holds 64 bits, so that every other data type can be loaded into a temporary reel without loss of precision.

By designing the 8087 around the temporary real concept, intel has simplified the application programmer's life in several ways.

· Since all data types are converted to temporary reel by the hardware, the programmer rarely need worry ebout explicit type conversions, it is just as easy for the programmer to multiply a double precision floating point number by a packed decimal number as it is to multiply two integers. (Of course, when storing a number back in memory, the progremmer remains responsible for ensuring that the destination dete type is lerge enough to bold the result being stored.)

• The range for temporary reals is (almost) Infinite. The exponent range is 10 to the +/-4932. As a result, overflows and underflows are elmost always caused by a bug in either the data or the program, and only rarely indicate a numerical computing error.

• The temporary real bas 19 significant digita. Even when a long series of intermediate calculations produces significant cumulative round-off error, the loss of 3 or 4 digits of accuracy still leaves en accurate double precision answer. With the 8087 onboard, an IBM Personal Computer is more accurate than the stendard IBM mainframe!

Word integer. Word integer corresponds to BASIC's integer data type. A word integer occupies two bytes of storage and is principally used to index arrays and other data structures.

Y DESIGNING the 8087 around the temporary real concept, Intel has simplified the application programmer's life in several important waus.

Short integer. A 4-byte integer. Not usually used in numerical programming. Long integer. An 8-byte integer. Not usually used in numerical programming. Packed decimal. Packed decimal repre-

sentation is used for business end data processing operations. A packed decimal uses 10 bytes of memory and contains 18 decimal digits. Unlike the three preceding data types, the packed decimal form uses a decimal rather then a binary representation. Each of the decimals 0-9 is represented by four binery bits. These decimal digits are then "packed" two to a byte.

Business and data processing programs generally spend much more time converting data between external (ASCII) end internal (binary) representation than doing arithmetic. Conversion between ASCII and packed decimel representation is quite easy. (Also, some data processing languages, such as Cobol, usa packed decimal representation as a standard data type.)

 $T_{\!\scriptscriptstyle HE\, LEADING}$ bit of a floating point number is always a one. The computer shifts the significand left or right, while decreasing or increasing the exponent, in order to maintain this format.

Floating Point Representation

8087 floating point representation makes a number of concessions to the computer's convenience.

- Numbers are represented, unsurprisingly, by a string of binary bits rather than decimal numbers
- The position of the "binary point" is implicit. Since computer memory contains only zaros and ones, there is no convanient way to explicitly write in a decimal point. In ordinary scientific usage wa writa 153.7 as 1.537E2 (Computers typically use "E" in this context to indicate multiplication by a power of ten.) If our type font had no period, wa might egree to write 153.7 as 1537E2 and agree that a decimal point is implicit after the first digit. On the 8087, the binary point is assumed to appear immediately to the right of the most significant bit of the significand.
- · Floating point numbers are represented in a "normalized" format. Tha leading bit of a floating point number is always a one. The computer shifts the significand left or right, while decreasing or increasing the exponent, in order to maintain this format.
- Since single and double precision

numbers are always normelized, the leading bit is always a one and therefore needn't be stored. It isn't. The leading bit is stored in the 80-bit tamporary real for-

met. · Exponants in scientific notation can be either positive or negative. Rather than store an explicit sign bit for exponents, the 8087 uses e "biased exponent." The exponent field holds the sum of the true exponant and a positive constant. For axample, the exponent stored in e single precision real number is the true exponent plus 127. The exponent bias, chosen to provide the widest possible range given the number of bits assigned to hold the exponent, is 127 for single precision, 1023 for double pre-

cision, and 16383 for temporary real. To illustrate floating point representation, the significand of 2.0 is "[1]00 . . . " (where the "[1]" indicates the leading 1 is assumed but not stored and "00 . . . " indicates arough zaros to fill out the rest of the significand field). The exponent of 2.0, for single precision, is 127. Examples of significand and exponent fields for other numbers are: 1/2 is "[1]00 . . . " and 126; 3.0 is "[1]10 . . . " and 127; and 4.0 is "[1]00

and 127. Zero is represented by all exponent and significant bits set to zero. (The sign bit

out significance for any arithmetic or comparison operation.)

Integer Representation

The three integer types are represented in "two's complement" format. Positive numbers are simply binary integers. Negative numbers are represented in the following way: If X is a positive integer, then -X is written as (NOT X) + 1. The leftmost bit of an integer is always a l for negativa intagers end 0 for zero or a positive

Packed Decimal Representation

Peckad dacimal numbers are integers represented with a sign and axactly 18 decimal digits. Bits 0-3 hold the least significant digit, i.e. the "one's place." Bits 4-7 hold the "ten's place," etc. Bits 72-78 are unused. (If an additional digit were stored here, it would not elways be possible to convert a packed decimal number into an 8-byta integar.) The high-order bit, bit 79, holds the sign. If a decimal digit is not in the required range 0-9, the result of using the packed decimal number is unde-

As an exercise, try writing out a number in each of the seven formats. (Note that 127 is 01111111 in binary or 7F in haxamay be either positive or negative, withdecimal.)

Pattern Incompatibility

Combining pre-8087 software and 8087-compatible software will usually produce garbage.

Until the introduction of the 8087, personal computers based on the 8088 family had hardware for intager arithmetic only. Since there was no hardware "with an opinion" on how nonintegers should be represented, each software dasigner was free to choose his or her own petterns. In practice, this meant that whoever built translators for programming languages (compilers, interpreters, and assemblers) mada tha decision for averyone using a particuler language. Since Microsoft has been the principal supplier of programming languages for 16-bit computers, the vest bulk of software uses the patterns chosen by Microsoft.

Unfortunately, the Microsoft pattern and the Intel 8087 pattern are different. The result of this conflict is that pre-

8087 software and 8087-compatible software cannot trade data represented in their respective internal formets. With your 8087 in placa, you can sefely use either pre-8087 or 8087-compatible software. If you try to combine programs produced with pre-8087 or 8087-compatible translators, you will usually gat garbage. Further, if you try to exchange data between such programs you will get garbage if the data was stored using the computar's internal formet. If the date is not stored in the internal format, then the programs can probebly axchange dete

There isn't e general rule as to whether a conflict will occur between two pieces of software: you need to know the particulars of each program.

The following is on excernt from "BASIC and the 8087" (Chapter 8).

Assembly language subroutines, in combination with BASIC programs, join the

decimal representation is used for business and data processing overations.

convenience of a high-level language with the speed of the 8087. In this chapter, we discuss the software conventions that must be observed in writing the 8087 routines, ilf you want to use the 8087 procedures in this book for languages other then Microsoft BASIC, you may have to observe different conventions.)

Calling a Subroutine

Calling e subroutine requires three tasks. First, we have to set up a list of arguments that can be retrieved by the subroutine. Second, we have to store away a return eddress in a plece the subroutine can find. Third, we jump to the subroutine. The CALL instruction takes care of the latter two tasks. The first is accomplished by pushing the eddresses of the

erguments onto the 8088 steck. Calling a subroutine is most easily explained with an illustration. Suppose we wanted to imitate the following BASIC

DEF SEG=&H1800 SUR=0 CALL SUB(A(O), SUM, N)

code

We could use the 8088 program in Figure

1. ASSUME CS... ASSUME promises the essembler we will set up the segment registers appropriately. 2. CSEG SEGMENT CODE. Tell the assembler we are beginning tha coda seg-

3.4 MOV AX DATA SEGMENT and MOV DS.AX. Put the eddress of the date segment into the data segment register, by trensferring it through the AX register. We require two steps because the MOV

Figure 3: An 8088 program to illustrate calling a subroutine.

ASSUME	CS: CSEG, DS: DATA_S	SEGMENT, SS:STACK_SEGMENT	;1
CSEG	SEGMENT	'CODE'	;2
		: MOVE ADDRESS OF DATA SEGMENT	
MOV	DS, AX	THROUGH AX INTO DS	:4
		: MOVE ADDRESS OF STACK SEGMENT	
MOV	SS, AX	; THROUGH AX INTO SS	;6
MOV	SP.OFFSET STACK_	; SET SP TO STACK TOP	:7
MOV	AS, OFFSET A	; PUSH ADDRESS OF A	;8
PUSH	AX	; ONTO STACK ; PUSH ADDRESS OF B ; ONTO STACK	;9
MOV	AX, OFFSET SUM	; PUSH ADDRESS OF B	;10
PUSH	AX	; ONTO STACK	;11
VOM	AX, OFFSET N	; PUSH ADDRESS OF N	;12
PUSH	AX	: PUSH ADDRESS OF N : ONTO STACK	;13
CALL	FAR PTR 1800H:0	: CALL SUBROUTINE	;14
NEXT_LOCAT	ION: ; RETURN HER	E WHEN SUBROUTINE ENDS	
CSEG ENDS			:15
DATA_SEGME	NT SEGMENT 'DATA		;16
A DW 1			;17
SUM DW ?			;18
N DW 1			;19
DATA_SEGME	NT ENDS		;20
	ENT SEGMENT 'STA		;21
	DW 100 DUP (;22
	EQU THIS WORD		:23-
STACK_SEGM			;24
	END		; 25

instruction ellows immediate operands, like an eddress, to be moved into memory or e general register, but not into a segment register.

5-6. MOV AX.STACK_SEGMENT and MOV SS,AX. Put the address of the steck segment into the stack segment register. Note that we do not have to load the code

segment registar. Someone else must heve elready done this for us since we can't executa code to load the code segment register, or to do anything else until the code segment register is loaded. The program that calls our subroutine is responsible for loading CSEG into CS. (And bow does that program get CS loaded? And the one that calls it? The operating system initially loads the CS register when it first calls BASIC (or whatever). The CS value for the operating system is wired into the hardware.)

7. MOV SP. OFFSET STACK_TOP. Set the stack pointer register to point to the memory location after the end of the stack area We could have written "MOV SP.STACK

AREA + 200" with identical results. But by doing it this wey, the essembler will load the correct address for the steck ton avan if we decide to change the size of the stack in line 22.

8-9. MOV AX, OFFSET A end PUSH AX. We now push the eddresses of the erguments onto the stack, in the order of appearance in the CALL statement. Since PUSH does not allow an immediate operand, we have to go egain though a generel register. The assembler directive "OFFSET" tells the assembler to load the address of A rather than the velue of the number stored in A. (OFFSET means use the eddress reletive to the beginning of the segment.) The convention of passing the eddress of en argument, instead of its velue or its name, is sometimes called e "call by eddress." 10-13. MOV AX. OFFSET SUM and PUSH AX and MOV AY OFFSET N and PUSH AY The addresses of SUM and N are pushed in a similar manner. Notice that no distinction

is made between a scalar variable and the

first word of an arrey.

 CALL FAR PTR 1800H: 0. CALL e FAR procedure. The current contents of the CS register and the Instruction Pointer (the address NEXTLOCATION) are pushed onto the stack. Then CS is set to 1800H. ("H" indicates hexedecimal to the assembler just es "&H" does to BASIC. Hex eddresses start with a digit, not a letter; e.g., 0AH, not AH, so that the essembler can distinguish e number from e name.) The program then jumps to location 0 in e code segment beginning at 1800H. (Remember that segment registers always have 4 zero bits added et the

15. CSEG ENDS. Tell the assembler we are ending the code segment. 16. DATA_SEGMENT SEGMENT 'DATA.'

Tell the assembler we are beginning the data segment. The compiler is smart enough to know that "OFFSET A" is an eddress in the dete segment end that OFF-SET STACK_TOP is an address in the steck segment.

17. A DW 1000 DUP (?). Set aside 1000 uninitialized words for A.

18. SUM DW ? . Set aside one uninitialized word for SUM

19. N DW 1000. Set aside one word for N. initielized to 1000 20. DATA_SEGMENT ENDS. End the dete segment.

21. STACK_SEGMENT SEGMENT 'STACK. ' Begin the steck segment.

22. STACK_AREA DW 100 DUP (?). Set eside 100 words for the stack. 23. STACK_TOP EQU THIS WORD.

STACK_TOP is equivelent to the eddress eppearing after the 100 words ellocated for the STACK_AREA.

24. STACK_SEGMENT ENDS. End the stack segment.

25. END. End the progrem. The receiving subroutine finds the DS and SS registers pointing to the date and steck points to 1800 hex. Most of the important information eppears on the stack, which is shown in Figure 4. Remember that the 8088 stack actually grows upside down in

T TAKES one instruction to retrieve the address of the argument; two to retrieve the argument's nalue.

memory, so that as we push eddresses onto the stack, SP moves toward zero. Since we have pushed five words onto the segments defined ebove. The CS register steck (three argument eddresses, CS, end NEXT_LOCATION), SP equals (STACK _AREA + 200) - 10.

Acting As a Called Subroutine

Machine lenguage subroutines called from BASIC must obey a number of rules. The important ones are as follows: · At entry, CS is set according to the last

DEF SEG. The other segment registers point to the beginning of BASIC's data

 At exit, all segment registers and registers SP and BP should hold their original values. The other registers, and the flegs, mey be changed.

 BASIC promises that the stack pointed to by SP will have eight free words. If the subroutine needs e larger steck, it must set up its own.

 The subroutine must pop the argument eddresses off the steck before returning.

See Figure 5 for a subroutine, to edd up an array of integers, in e form thet could be

called by the code sequence eppearing in the preceding section. 1-3. The PUBLIC, ASSUME, and SEG-

MENT stetements supply the usual informetion to the essembler. 4. PROC FAR tells the assembler that this routine will be called with e FAR CALL;

information needed to generate the proper type of return instruction in line 18 5. PUSH BP. Save the velue of the BP register by pushing it onto the steck for later

re 4: Five words (three argument addresses, CS, and NEXT. ed onto this 8088 stock. Notice that SP moves toward zero. es, CS, and NEXT_LOCATION) have been STACK_AREA+198 OFFSET A OFFSET SUM OFFSET N STACK AREA+190 NEXT LOCATION <==SP

Figure	5: A s	ibroutine to add up	an array of integers.		2.8019	-
		IC SUB	and something	15.		;1
		ME CS: CSEG	ALL THE PARTY OF T	110		;2
CSEG		ENT 'CODE'	SECRETARY OF LANDING LAND	3 24	一个推出	:3
SUB		FAR	TO BUT AND LINES.	1.41	F. R. Liberton	4
			SAVE BP		11000	5
	MOV		FIND ARGUMENT LIST	100		;6
		BX,[BP]+10			11 30/07	:7
		SI,[BP]+6;		1 3, 1	270,000	;8
52.25ki			CX GETS N			;9
179	MOV	AX.O	CLEAR AX	in the		;10
ADD_			44,007,000	330		;11
o Mag	ADD	AX, WORD PTR [1 BX.2	BX] ADD A[BX] NEXT ELEMENT	174851		;12
EL CONT	LOOP	ADD_LOOP	DO IT AGAIN	10-10	1.1984	:13
	LUUP	AUULLUUP	;DU II AGAIN	221	-55	
	MOV	DI.[BP]+8	: ADDRESS SUM	352	1333	:15
	MOV	(DI).AX	STORE SUM	经报:	+93914	:16
1.15	POP	BP	RESTORE BP		3.7	:17
	RET	6.	RETURN			:18
SUB	RNDP	100000000000000000000000000000000000000		122.00		:19
	ENDS	365 47 MESET		HEE	of thirds	:20
20 RS	END	St. C. Carlo	Edition 1	23.		:21
	END			in it	(

retrieval. Note this instruction subtracts 2 from SP, so SP now equals STACK_AREA

 MOV BP, SP. Copy the stack pointer, SP, into BP. The instructions thet follow retrieve information from the stack. BP can serve as a base register, as in [BP],

while SP cannot.

7. MOV BX, [BP]+10. Copy the contents of [BP] + 10 into BX. Since BP equels STACK_AREA' + 188, [BP] + 10 is

STACK_AREA + 188, IBP| + 10 is STACK_AREA + 198, STACK_AREA + 198 holds OFFSET A, so after this instruction BX holds the eddress of the first word of A.

8, MOV SI_[BP]+6. By the same logic,

move the address of N into Sl.

9. MOV CX, [SI]. Now move the value of N into the count register, CX.

10. MOV AX.O. Clear out the accumulator, AX.

 ADD_LOOP: . Label the top of the loop. Notice that this loop does not worry about errors such as negative or zero N nor about the accumuletor overflowing. (Not very good programming practica!)

 ADD AX, [BX]. Add the elemant of A currently pointed to by BX into AX. The first time through, this is A(0); the second time. A(1): and so forth.

13. ADD BX, 2. Increment BX by 2 so it points to the next word.

14. LOOP ADD_LOOP. Decrement the count register end jump back up to the top

of ADD_LOOP if we haven't run the count down to zero. 15. MOV DI, [BP]+8. Move the address of SUM into DI.

ANY subroutine that explicitly contains a value for a segment register is not relocatable.

16. MOV [DI], AX. Move the contents of AX into the eddress pointed at by the DI register, i.e., into SUM.
17. POP BP. Now restore the original value of BP. Also, add two to SP.

18. RET 6. Set the Instruction Pointer to

point to NEXT_LOCATION and set CS equal to CSEG, in the process add 4 to SP. Add tha optional pop value to SP. Now SP equals STACK_AREA + 200, as it did before the subroutine was called.

19-21. SUB ENDP and CSEG ENDS and END. Tell the assembler to close up the procedure, segment, and program.

In coding the subroutine, a pettern appears.

by Pears. With a representation of the first part of the first

addresses are velid ofter we set BP, as in lines 5 and 8, with a PUSH and e MOV.)

It takes one instruction to retrieve the address of the argument; two to retrieve the argument's velue.

The last instruction should be RET
or 2*n, where n is the number of argu-

Subroutine Relocation and Segment Addressing

The BASIC command BLOAD allows us to load e subroutine et any memory location. It is therefore bighly desirable that our 8087 routines be dynomically relocatoble. We can run into difficulty if the segment eddresses et which a routina

is initially loaded diffar from those at which we later BLOAD the routine. Dynamic relocation is eutometic for programs that do not explicitly reference seg-

SUBROUTINE
SILLY will work if
loaded and used at one
location, since the
loader will figure out
the value of
EXTRA SEG

ment locations, but somewhet more complicated otherwise.

For the purposes of this discussion, suppose we had initially loaded SUB with DEF SEG=&H1800 end the BSAVED it from this location with an offset of 0.

Suppose we now loaded SUB back in at DEF SEG=&H1900. When BASIC calls SUB, it sets the code segment register to &H1900 and the instruction pointer to zero. Execution proceeds correctly.

Suppose instead that wa load SUB et DEF SEG=#H1900 end offset 125 SUB

The 8087: An Add-On Device for the PC

Why wasn't 8087 combined with 8088 to include all the capabilities on one chip?

From e programmer's viewpoint, the 8087 edds edditional instructions to the 8088's repertoire and makes evailable additional processor registars. Why not include all the capabilities on one chip, rather than create an add-on device? There are several reasons:

• The 8887 is an extraordinarily sophisicated computational device, including 75,000 transistors on a single chip. Even though the 8887 is "limited" to numarical processing, it is much more complex (and more expansive) than the general purpose 8088. Building two separate chips holds down development costs and ellows users and system manufacturers to tellor-fit sysand system manufacturers to tellor-fit sys-

tams for different uses.
 The 8088 (and its 16-bit bus sibling, the

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Figure 6: The subroutine SILLY above illustrates the problems of defining an extra segment inside a routine.

		SEGMENT 'DATA'		:1
FOOLI:				;2
EXTRA.	_SEG E	ENDS		;3
;SUBR	DUTIN	E SILLY (JUNK	%)	
	PUBL:	IC SILLY		:4
	ASSU	ME CS: CSEG, ES:	EXTRA_SEG	:5
CSEC		ENT 'CODE'		:6
SILLY	PROC	FAR		:7
OXDD.	PUSH			. B
		BP.SP		:9
	MOAF	DP, SP		,9
	PUSH	ES	; POINT ES	;10
	MOVE	AX, EXTRA_SEG	; AT	;11
	MOVE	ES, AX	; EXTRA SEGMENT	;12
	MOVE	AY FOOT TON	: RETURN WHATEVER	:13
		DI,[BP]+6		:14
			:LAYING AROUND	:15
	POP		; LATING AROUND	
				;16
	POP			:17
	RET	2		;18
SILLY				;19
CSEG	ENDS			;20
	END			;21

"thinks" it will find the first instruction at offset zero in the code segment. Actually, the first instruction is at offset 125. However, when we call SUB we specify the offset. BASICs east the instruction pointer to 125. All the instructions we have used, though not every instruction the 8088 knows, operate relative to the instruction pointer. SUB still executes correctly.

SUB is fully relocatable. What sort of subtroutine isn't Unfortunately, any subroutine that explicitly contains a value for a segment register is not relocatable, since
the segment may end up at some other
memory location than the one originally
specified. This is particularly a problem
when we define a data, extra, or stack segment inside a routine. Consider the not
very useful routine in Figure 8.

very the unit routine air rigative. This subroutine references the strassegment (if not only speed protein), and the segment (if not only speed partnershold. It have 10, 11, and 12, save 15 on the stack, and then load the address of EXTRA_SEG. Into ES. Line 13 copies FOOLISH, Note that the assembler should be smart enough to use ES to reference FOOLISH, Subroutine SILLY will work if leaded and used at one location, since the loader will fissure

THE 8088 requires segments to be placed at addresses that are even multiples of

out the value for EXTRA_SEG. However, if we relocate SILLY, EXTRA_SEG will no longer be at its original location, and

unpredictable consequences my ensue. We can make SILLY relocable by having the subroutine figure out for itself how far it's been moved from its original location. The subroutine "thinks" it begins at location in CFCSEG. In truth, or CFCSEG in the MB LOADED by interpreted BASIC, SILLLY, the subroutine thinks the extra segment begins at 16°ESTEA. SEGAMENT, while it actually begins at 16°ESTEA. SEGAMENT | 416°DEF SEG* of 66fes-1616*CSEGNENT | 416°DEF SEG* of 66fes-1616*CSEGNENT |

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Figure 7: Subroutine SMART with the code segment and extro segment loaded together at a memory location that is an even multiple of 16.

EXTRA SEG	SEGM	ENT 'DATA'	;1
FOOLISH			:2
EXTRA_SEG			:3
	-		,-
SUBROUTIN	E SMAR	T (JUNK%)	
	BLICS		:4
		S: CSEG. ES: EXTRA_SEG	:5
CSEG SEGME	NT	'CODE'	:6
FIRST_INST			:7
SMART	PROC	FAR	: E
	PUSH	BP	:9
	MOV	BP.SP	:10
	PUSH	ES	:11
	CALL	NEXT	:12
NEXT:	POP	AX	;13
	SUB	AX, (OFFSET NEXT)-(OFFSET FIRST_INST)	;14
	MOV	CL.4	:15
	SHR	AX, CL	;16
	MOV	BX, CS	;17
	ADD	BX, EXTRA_SEG	:18
	SUB	BX, CSEG	;19
	ADD	AX, BX	;20
	MOV	ES, AX	:21
	MOV	AX, FOOLISH	;22
	MOV	DI,[BP]+6	;23
	MOV	[DI], AX	;24
	POP	ES	;25
	POP	BP	;26
	RET	2	;27
SMART	ENDP		;28
CSEG	ENDS		;29
	END		;30

can use this reletion to correctly load segment registers. Life is complicated a slight bit more because the only wey to find "offset" is by exemining the value of the instruction pointer at entry.

The following subroutine, SMART (see Figure 7), will work correctly, as long as the code segment and extra segment are looded together of a memory location that is an even multiple of 16.

Lines 1-6, 8-10, 22-24, and 27-30 are standard.

 FIRST INST EQUITHIS WORD. Define the location of the first instruction in the code segment to be FIRST_INST. (FIRST INST equels zero here.)

 PUSH ES. Seve ES on the stack. Note we don't change BP so argument references don't change.

12-13. CALL NEXT and NEXT: POP AX.

$T_{\!\scriptscriptstyle HIS}$ manivulation is w

manipulation is worth the extra trouble to more easily load subroutines into BASIC.

This is a devious way to retrieve the instruction pointer. CALL pushs IP onto the stack. (The instruction pointer will point to the true offset of NEXT, no matter where the routine is located.) POP pops the stack into AX. Now AX holds the true offset of NEXT.

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14. SUB AX, (OFFSET NEXT)-(OFFSET FIRST INST). Now we subtract the exnected offset of NEXT from the true offset AX now holds the number of bytes by which the offset of SMART has changed as compared to the position at which it was originally loaded.

15-16, MOV CL. 4 and SHR AX.CL. Divide AX by 16 since we are going to set a segment register. Notice that if the program was relocated by any number other than on even multiple of 16, the program will bomb in on unpredictable monner. Nor will any other method work, since the 8088 requires segments to be placed at addresses that are even multiples of 16. 17-19, MOV BX.CS and ADD BX.EX-

TRA SEG and SUB BX. CSEG. Figure out how far the code segment has been displaced from its original location and how far the extra segment is from the code seg-

20-21. ADD AX, BX and MOV ES. AX. Combine the offset and segment correction and set ES.

25. POP ES. Restore ES before leaving the routine.

While all this manipulation is a bit of a nuisance, it is worth the extra trouble to be able to more easily load subroutines into BASIC. If you only use a compiler, then relocation is handled by the LINK program and this extra code is unnecessary.

Figure 8: An interactive session for loading FOO into interpreted BASIC, Your responses hove been underlined.

B>A:MASM

THE IBM PERSONAL COMPUTER MACRO ASSEMBLER VERSION 1.00 (C)COPYRIGHT TRM CORP 1981

CALL NEXT

0004 E8 0007 R ERROR-

64: NEAR JMP/CALL TO DIFFERENT CS

WARNING SEVERE

ERRORS ERRORS

B>A:LINK

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OBJECT MODULES [.OBJ]: FOO/HIGH/MAP RUN FILE [FOO.EXE]: LIST FILE (NUL. MAP): FOO: WARNING: NO STACK SEGMENT

THERE WAS 1 ERROR DETECTED.

B>TYPE FOO. MAP LOADING HIGH

WARNING: NO STACK SEGMENT START STOP LENGTH NAME CLASS. 00000H 0002AH 002BH CSEG 00030H 00031H 0002H EXTRA_SEG DATA

ADDRESS PUBLICS BY NAME

0000:0000 SMART

ADDRESS PUBLICS BY VALUE continued on next page

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Loading Assembly Language

Programs
At the end of the chapter, we show two
complete interactive sessions in which
SMART is used in a BASIC program: one
session for the interpreted BASIC built
into the IBM Personal Computer and one

remainder of this chapter describes the general steps involved. These procedures focus more specifically than most of the material in the book on the IBM Personal Computer running PC-DOS. If you have a different machine or different software (especially if you are not using Microsoft software), you may have to adjust these software) you may have to adjust these

Figure 8 continued		100	3 1.4 1 - 1	4.9
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procedures somewhat.

Loading a Routine into Interpreted BASIC

The assembler transforms an 8087/ 8088 source program into an object module. Several further steps are required to

HE
assembler transforms an
8087/8088 source
program into an object
module.

get the routine into a form suitable for BLOADing into BASIC. These staps involve running the program through the LINKar, through DEBUG, and finally through BASIC. Suppose wa begin with a program held in file POO_ASM.

The assembler replaces the instructions and (most) addresses with their binary representation and creates a file FOO.OBI.

LINK is able to combine several different object files. It creates FOO.EXE.

We use DEBUG to load FOO.EXE. DEBUG figures out the actual memory address at which each segment begins. We can also ask DEBUG to tell us where the program begins.

Finally, we use BASIC to BSAVE the routine. Once the routine is BSAVED, we can BLOAD it whenever desired.

The exact procedure for getting from FOO.ASM to the BSAVEd version is described in Appendix C of the IBM FO ASIC Monuol. (The descriptions of LINK and DEBUG in the DOS manual supply some additional information.) That exact procadure may vary according to which version number DOS and BASIC you use. The steps described below usually work for the author.

 Assemble FOO.ASM (Ba warned that the assembler occasionally produces erroneous error messages.)

 Link FOO.OBJ. Tall the linker to load HIGH (LOW is the default). Get a MAP file from LINK so that you can find the total langth of the output file, FOO.EXE. If FOO



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doesn't have a stack segment, LINK will report its absence as an error. Ignore this message.

3. Enter the DEBUGer with DEBUG BA-SIC.COM. 4. Type "r" to examine the registers, Copy

down the values of CS, SS, IP, and SP. 5. Enter "N FOO. EXE." Type "L." This tells DEBUG to load your routine.

ask DEBUG to tell us where the program begins.

6. Type "r" again. Copy down the new

values of CS and IP. 7. Restore SS and SP by using the r command. Enter "RSS." The computer will tell you the current value of SS. Respond by entering the value of SS you copied down in step 4. Now enter "RSP" and

respond to the computer with the value of SP from step 4. 8. Enter "g=CS:IP" where CS and IP are replaced by the values copied down in

9. BASIC should start up now, possibly with an irrelevant warning about a DIRECT STATEMENT IN FILE. Execute DEF SEG=cs, where cs is the value of CS copied down in step 6. Execute a BSAVE

Figure 9: An interactive session for looding FOO into compiled BASIC. Your responses hove been underlined.

B>A: MASM:

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0004 E8 0007 R CALL NEXT

;12 ERROR --- 64: NEAR JMP/CALL TO DIFFERENT CS

WARNING SEVERE ERRORS ERRORS

B>A: BASCOM USEFOO;

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STATEMENTS filespec, offset, length command; where filespec gives the name of the file in which you wish to save the routine, offset is the value of IP from step 6, and length is the

length in bytes of FOO. From now on to use FOO from BASIC just do a "DEF SEG=" and "BLOAD filespec."

MESSAGES

EDITOR

COMMANDS

Loading a Routine into Compiled BASIC

Combining an essembled program with the output of the PC-BASIC compiler is considerably easier than loading the program into interpreted BASIC. 1. Assemble FOO, ASM, Include subrou-

tine nemes in a PUBLIC statement. 2. Compile the BASIC program. Omit

DEF, SEG, and BLOAD statements. You need not worry ebout the location of the subroutine in memory. 3. LINK the output of the BASIC compiler

together with FOO. 4. Execute the "EXE" module

Interactive Session for Interpreted BASIC

Assume that the routine SMART is in file FOO.ASM on disk B:. The following BASIC program is in a file HSEFOO BAS elso on disk B:

- 10 DEF SEG=&H1800
- 20 BLOAD ''B: FOO. SAV'' O 30 SMART%=0
- 40 F001.TSHE=9999 50 PRINT FOOLISHS 60 CALL SMART% (FOOLISH%)
- 70 PRINT FOOLISHS 80 END

See Figure 8 for a sample interective session for loading FOO into interpreted BASIC.

Interactive Session for Compiled BASIC

Assume that the routine SMART is in file FOO.ASM on disk B: The following BASIC program is in e file USEFOO.BAS. also on disk B:

- 10 FOOLISH = 9999 20 PRINT FOOLISHE 30 CALL SMART (FOOLISHT)
- 40 PRINT FOOLISHS 50 END
- See Figure 9 for a sample interactive session for loeding FOO into compiled BASIC.

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In creating games for personal computars the designer is confronted with a choice of two routes. He may, on the one hand, wish to take advantage of the computer's graph, and the computer is the computer of the computer is a classic example of this sort of game. With cot computers there would be no Spoce Invaders. Alternatively, the designer may simply wish to take an existing bond, card, or word games and write a computer version of its. Since the computer way be the computer than the configuration of the computer way be considered to the computer may be considered to the computer may be considered to the computer may be considered.

programmed to take the place of a human opponent, two-participant games, such as chess, are particularly appropriate for computerization.

The difficulty in programming chess or any other game, such as bridge or checkers, is that while it is straightforward enough to write a program to "play" chess, it is quite another matter to write a program that challenges the average chess playar.

THE COMPUTER
may be programmed to
take the place of a
human opponent.

As a chess master and professional programmer, I have always looked at chess programs with interest. I was especially intrigued to learn that two had recently been written for the IBM PC. Afar all, a very reesonable chass program, Sorgon, had been written years ago to run with 6% on a Z80-based system. Since software marketers may reasonably assums that a PC will have at least 64 K of memory and representations of the state of the state of the program should be vary easy to produce. In addition, the 8008 processor is much more sophisticated then the Z80. It is faster and its instruction set is far more powerful. Last, and not least, the PC has more than adequate graphics capabilities these-board. The original source code for Sorgon was published as a book in 1970. Its way published as a book in 1970. Its contract of the state of the producing a cheek graph of the producing a cheek game of an amicrocomputer.

Howdy, Partner

The first PC chees program to reach my walk. Chees Profits rby Scott Marray Software, came in an attractive little folder ware. Came in an attractive little folder of IBM ofference. The documentation, though it was typesat, was limited to a very brief three and a half pages. To my amusement it did not explain the rules of the content of the content

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lem of spelling en possant as en pessont. This made ma worry a bit about how much chess the author or authors ever played.

chess the author or authors ever played.

To my astonishmant the program requires 128K and a color/grephics board.

Since chess games beve been programmed in as little as ZK. 128K can only be consid-

FIEVER have need of a

cockroach on a graphics display I will not hesitate to model it after the Black Queen in Chess Partner.

ered excessive. It's totally unnecessary for a good game which alsa. Chess Portner does not provide. After trundling over to the local ComputerLand, which kindly provided ma with a PC-XTT, I tested Chess Portner's prowess. After prompting ma for one of six skill levels, it asked whether I prafarred White or Bleck Being en experienced chess player and no fool. I set the game's skill level at one. the lowest, and

chose the White pieces. Now, I consider myself an open-minded parson when it comes to graphics displays on computers. I realize that I em not going to get a displey that is as plaasing to the eye as a fine walnut and meple chessboard with a set of classically designed Staunton chessmen hendmade in boxwood. On the other hand, I certainly wes not prepared for what I saw next. A purple and nink chessboard took form before my eyes, followed by the most unprepossessing set of chassmen I have ever seen. Thase pieces did not ettempt to duplicate eny design aver used in printed chess diagrams. The knight was recognizable, though a bit squashed, the rook wasn't too bad, but the bisbops end pewns eppeared to heve melted into shepeless globules. The queens were truly astounding. If I ever heve need of a cockroech on a graphics display I will not hasitete to model it after the Black Queen in Chess Portner. It actuelly has two little legs. Apparently it also axhausted the creative energies of the dasigners who gave up on the king, which is simply represented by a large K.

as simply represented by 3 sirgs A.

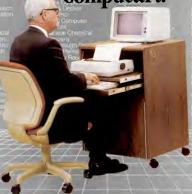
As for the game itself, Clease Portner
along form algebraic notation. If move any
long-form algebraic notation. If move any
ease, and the sirge of the sirge of the sirge of the
ease, It would be convenient if the game
allowed you to use descriptive notation
(P-K4) or short form algebraic (e4). The
first format is more common. the second is
quicker. However, entering 2e 4s is no real
hardship, and IT is sure this has helped to
keep tha program from growing bayond
128K.

Leveling Out

On level one, Chess Pertner register almost of one, to nole yespended stollad 7 seconds to leae the first games 1. ed. \$2 2.06.4 Me.\$3 Nc2 304.4 d.\$8.23 et a second a move Chess Portner was no doubt delighted to have something co-putrey! \$3. Nc2 304.8 d.\$6. ed. \$1.055 Y. Q.\$3 (Let's see how it responds to the property threats) Nc2 37 8. Q.\$7 mate (not well). So much for wondering about alphabets pruning or whether soons over method of

move persing has been discovered. Now parhaps this wesn't antirely feir on my pert. So I resat the ebility leval to two and triad again, 1, c4 d5 2, cd5 Nd7 (at lasst Chess Portner is original.) This move, however, loses a newn, I won quickly while gorging myself on Bleck pieces. This was beginning to pose a dilemma. Chess Portner's instructions indicete it has only six levels of skill, the lest three of which "are deemed too slow for normal gamas." Sinca ComputerLand has et least some passing desire to sell the system I was using, I wesn't at all anthusiastic ebout sterting e geme et a higher level. A normal tournament game runs about 4 hours. I shuddered to think how meny meels I would miss at level six. So I triad the manuel's suggestion of using the higher levals to solva e problam. I want beck to the menu and salected problem mode. Chess Portner then went through ell 64 squares of the board, prompting me to enter a piece. I decided to give Chess Portner e devious computer chess problem. White king on c2. e White pawn on g7, end the Black king on e1. White is to move end mete in two moves. Sinca 1. g8={Q} is stalemete, the solution is 1. g8={R}! Ke2. Ra8 mate. This little problem, published in 1868 by E. B. Cook, is devious only because so many computerized chess

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In California 415-974-5297 CIRCLE 208 ON READER SERVICE CARD games don't know the rules about underpromotion. They only allow queens. Chess Partner was no exception. It whirred and ground for 71/2 minutes and played 1. Kc1. Further investigation revealed it only allows pawns to be promoted to queens and knights! Amazing. A computer chass gama ought to at least play by the rules of chass. Anything lass is totally unprofessional programming practica akin to writing e General Motors payroll system that doesn't allow for en income tax in State of

Michigan. So much for higher levels of pley. I set Chess Partner back to laval three, described as "slow, but very smart and eggressive." The game proceeded 1, e4 e5 2. d4 ed4 3. c3. This is known as the Danish Gambit, After waiting for more than 10 minutes for Chess Portner to reply, I wished I had a Danish to munch on. Since this is totally outrageous (A 40-move game was going to take et least 6 hours if I responded instantly), I aborted the game and called lt e day.

No Sicilians and Other

Complaints I also discovered a number of other interesting features of Chess Partner. Pressing Esc aborts the game. This is nice, but if you press the key accidentally, tha game is over. There is no prompt to esk whether you really intend to quit play. Sinca Escape and 1 are next to each other on the PC's keyboard, it is vary easy to perform the alectronic equivalent of throwing the board and pieces at your opponent.

Chess Partner wants you to castle by capturing your king with your rook. This is all right, but it would have been nicer to have simply been allowed to move my king two squares, es in a real game. Chass Portner is endowed with an opening "book" that allows it to respond quickly on the first two moves. Common sequences are hard-coded in the program while it stores unusual sequences in a small disk file. If you open 1. e4 it responds 1 . . . a5 instantly, while If you try 1, e4 it reeds the diskette and than plays 1 . . . e5. You will notice that I said "it responds 1 . . . e5." Thet's right. It only plays 1 . . . e5 in response to 1. e4. No Sicilians, Frenches, Pircs or anything elsa, If you don't think this is a drawback, about ten games will convince you otherwise. PC MAGAZINE 452 SEPTEMBER 1983

You can't practice against a variety of openings. I tried satting up the first moves of the Sicilian Defence, 1, e4 c5, which was tedious to start with, but which revealed another problem with Chess Partner: If you set up e position, it always moves first.

Chess Partner also hes some bugs. It wouldn't allow Black to castle queenside, though White could. It elso has some problems displaying its menu screen properly.

No Game Is All Bad There are some features of Chess Port-

ner that I like. It hes two clocks that dispiay the eiapsed time of each player end even tick audibly. I'm glad the authors took adventage of the PC's clock to do this. The ticking can be turned off if it bothers you. Being a tournament player who plays most games with clocks, I found I ectually preferred the ticking sound to the eerie gulet of Chess Portner's Interminable thinking. Chess Partner eiso allows you to change the skill level at any time and to retrect moves. I know real chess plevers can't take back moves, but part of the reason to have a computer chess game is to practice. The manner in which Chess Partner retracts moves is enother thing. It sets up a fresh board and proceeds to replay the entire game except the last move. I'm glad I didn't retract the last move of e 60move game! While this method might antertain the neighborhood children, it is slow and unnecassary. Since Chess Port-

ACTUALLY preferred the ticking sound to the eerie quiet of Chess Partner's interminable thinking.

ner obviously retains all of a game's

moves, it could just pley the last move in reverse (e4- e2 instead of e2- e4).

Chess Partner also is not copy-protected, and the publishers offer to replace any defective diskettes within 60 days after purchase with a "sincere apology," I like Scott Murray's ettitude in regard

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to copy protection and replacement. The publishers seem well-intentioned, but this product should not be on the market. It is inadequate and unfinished. The programming is unprofessional, and no care was taken to make the game easy to use. A lot of work needs to be done.

Here Comes the Master

The second chess game appeared several weeks later in my mailbox. It has the terribly pretentious name of SPOC, the Chessmoster. SPOC stands for Selective Pruning Optimization Chess, which the authors claim is a new algorithm for the

Anyway, the instructions for SPOC won't tell you how to play chess. They do tell you, however, about going to jail if you steal the program and about how you are going to be out of luck in the case of a bad copy. SPOC is copy-protected, but the diskette is only warrantied for 90 days. Worse, if you get a bad copy it will cost you \$4 to have it replaced. This is an outrage. Regardless of what merits the game may have, I would not buy it for this reason alone.

Like Chess Partner, SPOC devours 128K of memory, but it at least gives you the option of using a nongraphics monitor. I feel this is an essential of a good chess program. After all, chess is not really a very graphic game. The only reason for graphics at all is so that you won't have to

use a chess board. Feeling that I might have worn my welcome a bit thin at ComputerLand, I went to Computer Mart with SPOC. Again I was kindly provided with an XT for my use. So I booted up DOS and inserted SPOC. The instructions for the program dwell upon this procedure for two entire pages in what I would not consider to be the most illuminating introduction to using diskettes under MS-DOS. SPOC then prompts for a level of play (1-9). The authors have the courtesy to tell you how much time SPOC will spend on its moves at each level. At level 1 SPOC will spend about 10 seconds per move. At level 9 it will take 60 minutes. Unless you are running a business burning-in PCs, I would suggest you not play any game at 60 minutes per move. The authors mention that level 6, which plays at 3 minutes per move, is tournament level. This corresponds to 40 moves in 2 hours, a somewhat slow time limit for American tournaments, but within reason. You could play a game in about 4 bours at this speed.

SPOC then asks whether you are using a color/graphics display and if you want the moves output to a printer. This is a nice idea. You can get a hard copy of a game as you are playing it. Since SPOC will save games on a diskette if you desire. it also asks whether you wish to resume a previous game that you saved on a diskette. At level 9 you probably will save your game frequently. Finally, SPOC asks whether you want White or Black.

To the Board

SPOC next displays the board. Lo and behold! It's also pink and purple. I bet all these authors wish IBM sold a pink monitor. SPOC features, bowever, a very attractive set of pieces. They look very much like a chess diagram and are easy on the eyes. I'm glad the authors recognized that bundreds of years of experience in publishing chess programs may have led to something aesthetically pleasing.

unusual manner. You use the arrow keys to position the cursor over the piece you want to move, then press Home. SPOC "picks up" the piece slightly. You then

OH CAN

get a hard copy of a game as you are playing

move the cursor to the square you want and press Home again to complete the move. If you change your mind about moving a piece, just put it back on its original square and press Home. This sounds easy, but is very laborious. The cursor is not easy to spot and you may make a lot of keystrokes for a move.

After SPOC replies, you must busily SPOC has you move the pieces in an search for the cursor. Good luck. It's not

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there. Experimentation reveals that it's on the square where SPCC moved its joint desan't show it to you. The more I used the curron the less I liked it. The algebraic notation used by Chess Parther is preferable. SPCC will displey captured pieces alongside the board and show you how much time was taken per move. I distille this scheme. I would have been stifted to see the elepsed times for the whole same, es you would in a tournament.

Balance Sheet

SPOC is a much better chees pleyer then Chees Portner. The various better provide o usable range of time limits, the display is good, and it really does pley reasonably. This is not to say SPOC is not without problems. It is shot through with them. First of all, it allows only pawrs to be promoted to queens. Honestly, it isn't that hard to produce a chees game that that hard to produce a chees game that that have the produce of the same that the PAJ as its first move (1 e.d as White 1, ed as Black). This is safe, but has no other virtue. It also loves to give check. For instance, I took Black in the following agene: 1.e 3e 2. 4d eds 3. 6d dd 5.(h position thet more commonly arises from 1.e 46 e 2. 4d is 3. eds eds) 4.Bbs (SPOC gives check-); 6. 3. eds eds) 4.Bbs (SPOC gives check-); 6. 3. eds eds) 5. Qe2+ (This sain to saying "Always look at your shoes while you walk—you might see a wind to sain to saying "Always look at your shoes while you walk—you might see a Most of the sain to saying be, Black and the better, but SPOC has done nothing horbits. Chase Pottne would have either some

SPOC also has the annoying hebit of going back to MS-DOS when e game is over. You must keep rerunning SPOC every time you want to play a new game. You also cannot set up positions, retract moves, or play another human using your PC as e \$2.500 chess set. Chess Portior allows this last feature, but I don't feel it's worth mentioning in their sales literature.

thing ewey by now.

ture.

SPOC elso hes no opening book to drew upon. This was e disappointment to

me in both games. Since PCs are endowed with disk drives, chess gemes should use them. Standard openings could be stored, or famous games from the pest could be put on the progrem diskette for the user to pley through. This would teke edvantage of one of the PCs importent feetures. It has

SINCE PCS are endowed with disk drives, chess games should use them.

e mass storage device, end chess is e game with an immense literature that can easily be put on diskettes.

Only SPOC provides you with the option of making e hard copy of your game, so I decided to pley a game and record it on a printer. Here is what came

1 02-03

2 e7-e5 3 d2-d4 4 e5xd4 5 e3xd4 6 d7-d5



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Not only did SPCC use an entire line for each player a move, it invented a new system of chess notation. It gave each "half-move" its own number. Thus When the west ill the odd-numbered moves, and listed makes all the odd-numbered moves, and listed makes all the over-numbered moves, and black makes all the even-numbered moves, and black makes all the even-numbered moves, and black so were point out that moves have been numbered the same way for 200 years so that move one encompasses both White's move and Black's reply. This is essentible standard, and if the euthors had were read with the substandard, and if the euthors had were ready these text, they might have encoun-

Chess Portner. Having used up all the Dess Portner. Having used up all the paper on the printer. I turned my attention to SPCC2 ability to save games. The instructions explain how to do this. You must use a separate diskette, but not just any diskette. SPCOse is to swar scheme for saving gemes. Since you must use MS-DOS to run SPCC, no doubt you will be luilled into believing the way it saves games he something to do with MS-DOS



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files. Wrong. SPOC has a better idea. If the diskette you use hes anything else on it, it won't when SPOC is she finished with it. Not only thet, but SPOC is selbe to save the magnificent number of eight games per diskette. This certeinly allows for expansion. A 40-move chess game can be saved

IF THE diskette you use has anything else on it, it won't when SPOC is finished with it.

in 30 to 240 bytes, depending on how clever you want to be. This is less than 2K for even the simplest of schemes. A tremendous use of e 160K diskette that can ordinarily hold as much as 320K of information.

At least SPOC can use a black and white monitor. The's something Live II. A chess board appears with letters for the men. The letters are white for green) on black for White and reversed for Block. Just try this on your PC. It is the most unreadable display I have ever seen. It is impossible to follow the gene without e chess set, unless you know how to play impossible to follow the gene within the chess set, unless you know how to play billindfolded. This is especially irribating since the simplest, nongraphic display is more attractive.

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his	very	sim	ple i	lispla	ay is	far	mor

Finally, SPOC is more expensive than Chess Portner. I cannot recommend it either. It has the besics in tow but lecks significant development features. Some other feetures are hard to use. Like Chess Portner it needs a lot more work. I would suggest buying several good chess books with your money end brushing up while weiting for something better to appear.

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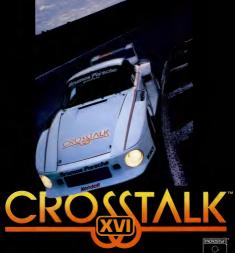


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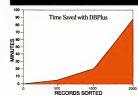
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SOFTWARE/STEPHEN MANES

The idea is inspired. And if this program worked well, the price would be a steal, but the fact is, Memory/Shift is too absent-minded to depend on.

Memory/Shift: Nine Heads Are Not Necessarily Better Than One

Memory/Shift (Version 2.0)

North American Business Systems, Inc.

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List Price: \$99
Requires: PC-DOS 1.1 or 2.0, one disk
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Admit it: Memory/Shlft sounds terrific. A

Number to Memory/Shift sounds territe. A hundred-buck program that lets you turn your PC into nine machines at once? Lisa, eat your heart out! Memory/Shift allows you to divide PC

Memory/Shift allows you to divide PC memory into as many as nine "partitions" as small as 32K (48K in DOS 2.0) or as big as you've got RAM for. Each partition works like a separate PC, and you can switch from one to the other at the touch of

a button. When you leave a partition, the program running in it stops executing, but when you return, you can pick it up precisely where you left it.

YOU CAN display two versions of your word processor one for notes, the other for current text.

Better still, you can move data from one partition to another. You can stick a spreadsheet into a report, move a deduction from your calendar to your tax form, copy a phone number from a database into

a letter, or switch from your communications package to WordStar to read a recently downloaded file without having to wade through mysterious Greek and

European language characters.

If you've got two display cards and two monitors, you can assign each partition to end the manual. Three crack editors at Amerimake this feature work for more threates the manual. Three crack editors at Amerimake this feature work for more threates the feature work for more threates the feature of the machine.) Memory/Shift elso allows you to put a spreaddered training progress to put a spreaddered training progress the color monitor while running VisiCulia.

notes, the other for current text. Or you

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It's a better idea, ell right. The mind conjures up visions of e movie called The Boost with Nine Broins, or a slightly seedy late-night commerciel for the Goldberg Nine-Wey Mervel: "R chops, minos, slices, dices, shreds, kneads, grinds, blends, and rices deta. What would you expect to pey for this mireculous product?"

T CHOPS minces, slices, dices, shreds, kneads, grinds, blends, and rices data.

Five hundred dollers? A thousend? Two? Well, hold on to your keyboard, we're offering it for the low, low price of just \$99. You heard right! It's like getting nine mechines for just 11 dollars eech! Order now, and we'll include e free comedy disk—Cary Kildall's complete pronouncements on the future of Concurrent PCM-88— et besolutely no extra cost!"

How Do I Crash Thee? Enough fentasy. Is Memory/Shift really

sherper than e Ginsu knife and more powerful than e Seturn rocket, or is it the letest pet rock?

Well, let's sey you really went to get

your money's worth out of Memory/Shift. You've got your word processor running in one partition, your detebase in enother, your spreedsheet in e third, your calendar in e fourth, and your communications peckage in a fifth. While the boss goes out for e coffee break, you switch to partition six to pley Dioxin Detoxer, en edventure geme with a thrill et every turn. Unfortunately, it doesn't understand your command, "nuke New Jersey," and goes deed on you. You press every combinetion of keys you can think of, but there is absolutely no response. Drive B begins meking funny noises. The only wey out is to turn off the machine end restart it.

You heve just witnessed e disaster of a megnitude unimegineble before Memory's shift: e six-bageer cresh, wiping out every bit of data thet's in the mechine end very likely messing up unclosed disk files as well.

Well, that's only theoretical, right? A

cautionary illustretion? Let's put it this wey: The on/off switch on my PC got more use the night I tried Memory/Shift than in any recent month I can remember.

Shifty Moves

The first thing you do with Memory!
Shift is use one of its batch files to copy
DOS onto it. Unfortunetely, neither the
manuel nor any on-screen message bothers to explain that the DOS disk you're
supposed to put into drive B must be the
complete IBM-DOS disk, or at least one
including SYS-COM and all the system

files on it.

This minor omission can cause major problems. When reconfiguring the Memory-Whife files in a change from DOS 11 to mixed system—that is, one that has one version of COMANDA COOM and e different version of the system files. This can weak utter hevo—or merely cause an eppearently inexplicable system has gap. All versions of the manual point out that CAM version of the manual point out that CAM versions of the manual point out that one of the configuration of the configuration

Once it's got the system files on it, the Memory/Shiff disk is reedy to go. You loed your system with any other programs thet will remein resident, such as disk emuletors, print spoolers, end hard disk drivers. Then you put the Memory/Shift disk in drive A and type MS.

The screen gives you e messege from Memory/Shift telling you that the progrem is copyrighted end that it was written by

THE ON/OFF switch on my PC got more use the night I tried Memory/Shift than in any recent month I can remember.

someone named Jonethan L. C. More. It elso indicetes how much memory is eveil-eble in each partition. In this case, you get the defeult setting: two partitions, one with 64K (or, I believe, 76K in DOS 2.0) and the other with whatever's left of mem-

ory. After you respond to the DOS time and date prompts, Pertition 1 shows you the femiliar A>, and you may do whatever it is you normally do upon saeing it.

When you feel the urga to open Partition 2, you hit either Alt-2 or Alt-Esc. The screen instantly switches, and an inversevideo line in the lower right corner of the screen tells you exactly which partition vou're in and how much memory is assigned to it. That line disappears with your first keystroke, which will probably be an Enter in responsa to time and data prompts. Though the documentation doesn't say so, Memory/Shift is able to pick up the current system time, and now Partition 2 is ready to do your bidding. To switch back, you hit Alt-1 or Alt-Esc. But if you've put any characters in front of a DOS prompt and you ask Memory/Shift to switch partitions, you have to hit Enter before anything will happen. Until you're used to it, it looks for all the world like a total system freezaup.

Faults and Defaults

What if you want more than two partitions? Simple, if you're the careful sort. You may invoke the program by typing ms n=X, s=A,B,C where X represents the number of partitions you want and A.B.C. and so on represent the memory size of each partition in K bytes. You must do this exactly right. An upper-case N or S will get you a "syntax arror" message. If you specify too much memory, you'll get a "memory allocation" error. And If you happen to omit the memory size specifications, guessing that there must be some built-in defaults, guess again. The machine goes into a dead hang that can be overcome only by turning it off and starting up again.

The other way to change the defaults is to run an installation program. That has a few zingers in store, too. The manual says the installation program's default setting is the same as the bootup: two partitions with a minimum of 64K each. This seems to be true—sometimes.

Whan I ren the program with my disk emulator in place, that default is the ona I got. When I rebooted to take advantage of my PC's 576K of mamory, the default seting turned out to be eight partitions with 64K eech. I accepted it; whet I got wes a setup with sevan 64K partitions and an eight with 110K—a total of 556K.

I tried again, refusing the default. This

time the installation informed me that I had a 544K system and could install up to nine partitions. But when I went to install those partitions, I was told I had 558K of

THERE'S NO way of finding out how Memory/Shift has been configured without actually invoking it.

"allocatable memory"—the amount the default chose to use.

I'm still not sure what's going on heer. The folks at North American Business Systams say Memory/Shift is set up to "sea" only \$125.00 that fait can set up partitions adding up to more than that because the partitions shere a single copy of DOS. That sounds fishy to me. If its raw, why did the program tell me is had a trace, why did the program tell me is had a did North American warn me that a \$240. All the control of the

This, incidentally, was an "improved" installation program. I won't bora you with the crazy math the first one came up with.

with The installation program lats you chenge the key combination that selects each partition. If you have a graphics card, you can choose each partition's text mode foreground and background colors, including "magneta" and "light magnata," and decide whether you'll save the full graphics display mamory or only one pege (the ramifications of which, once again, are almost totally undocumented). If you have two displays, you may choose which one will display each partition. You can disable disk checking, and you can reassign the keys used to change partitions, mark data, and move it. The manual claims that Alt-?-the Help key-is the only one that can't be reassigned. The more observant among us will note that F1 and F2 can't aithar. And the more irritable will complain that there's no way of finding out how Memory/Shift has been configured without actually invoking it.

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Once you've got Memory/Shift work-

With a color monitor, you get to change the foreground, background, and border colors as well. Unfortunately, on the IBM color display we had running for at least 15 seconds at a time, DOS insisted on blinking every time we did anything with it. Given the Parity Error 2s we kapt getting, we never gof far anough to discover what would happen with a real application program.

Shifting Bytes

"Just what is the 3200-byte buffer?" asks one of the menual's headings. To the utter amazement of those who expected a polishing cloth for a school of piranhas, it turns out to be what you use to transfer data within the same partition or from ona partition to another.

GIVEN THE
Parity Error 2s we kept
getting, we never got far
enough to discover what
would happen with a
real application
program.

To put information into this infamous 3200-byte buffar, you press Alt and tha Grey Plus (+) kay. A pop-up manu informs you that the Gray Plus kay appands data to the buffer and that the Gray Minus (-) kay clears the buffer out before data is acquired. After making the choica, you define a block of data by mov-

ing the cursor around to mark the upper left and lower right corners of an imaginary ractangle on the screen.

nary scalengle on the screen. Whenoy/Shift table command during this operation, and its low-shaped cursor can be made to go anywhere on the screen, regardless of whether the program would be made to the cursor and of the street, processor of the cursor and of the street, processor of the cursor pad—Home. End. Pg Up and Pg Dm—taks you to the corresponding corrans of the cursor screen.

corrass of the screen.

After reaching the first of the two defining corners, you press the spece har. Then you move the cursor to the diagonally opposite corner and press the spece har deed—though what this means depends on what's on the screen. Somehow the marked section of the screen will look different from the rest, but whether it will be in high-intensity, inverses video or asactly what depends on what's on the screen. Somehow the screen will be defined the screen will look different from the rest, but whether it will be in high-intensity, inverses video or asactly what depends on what's on the screen.

Terminator with Extreme Prejudice

Another pop-up menu tells you to "Ente ksystrokes to be appended to each line." This confusing instruction is the key to successful data transfer with Memory/Shift, but the documentation doesn't begin to axplain it. Be it a carriage ratum or marely a speace, some sort of line ateminator is nearly always required for successful data transfer.

When you dump date to the buffer, Memory/Shift reads it from the screen. This means it is totally ignorant of important invisible characters such as carriaga returns. Nor can it read control characters: to Memory/Shift, 2°C is two characters—a caret and a C. This can fool you badly when using a program that uses the caret convention for displaying, but not storing, control characters.

Furthermore, Memory/Shift observes, particular (and, needlass to say, undocumanted) conventions in the way it reads that screen. It ignores blanks at the and of any lina, and it ignores all blank linas. That's why it's absolutely imparative to use terminator characters; otherwise the last item in each line will run smack up against the first item in the next. In the access of a program like WordStor, a blank

usually does the trick, since a carriage return would inhibit reforming paragraphs. If you're moving entries into a database or spreadsheet, you've got to consider what kinds of commands should follow each line

Once you've typed in the terminator

ND THOUGH the manual breathes not a word of the fact, you can transfer only ASCII and extended ASCII

characters.

character or characters you want, you hit the illogical F1 to put them at the end of each line or F2 at the beginning. A copy of the marked block goes into the buffer, and you're back to your program. If you want to tack more data onto what's in the buffer, you have to go through the whole process again. Memory/Shift's data-capture mode only works one screen at a time. And though the manual breathes not a word of the fact, you can transfer only ASCII and extended ASCII characters. According to North American, the data-transfer mode doesn't work with noncharacter graphics Whether this means it will crash is left to our imaginations.

Since your screens rarely have every position filled with data, the 3200-byte buffer amounts to a little over two screens. If you try to overflow the buffer by appending too much data to it, you usually discover that Memory/Shift has highlighted only the amount of data it has room for. Once you hit the space bar to dump the data, you sometimes get a message to the effect that the remaining highlighted text didn't get in. Sometimes you don't. And one time I got that message along with a spectacular light show as the text on my screen oscillated between high intensity and low in a charmingly artistic but apparently random way.

Depositing Data

Once you get where you want the data in the buffer to go, all you do is press Alt and Gray Minus. This maneuver doesn't

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clear the buffer, so you can use its contants again and again if necessary.

Whan you call data from the buffer. Memory/Shift brings it in sarially, as if it were typed. This is none too speedy. It can take nearly a minute and a half for Word-Stor to process a full buffer of text. Frighteningly inaccurate scraens appeared during the process, but averything cleared up the instant data transfer was complete. But if you happen to be transferring to the middle of a WordStor file and you've forgotten to change the program from the overtype to the insert mode, you'll watch in horror as the incoming data wipes out avarything below it.

Data transfer presents other sticky problems because of incompatibilities between programs. Moving a wide spreadsheet into a program like WordStor will have to be done one screen at a time and

RIGHTENINGLY inaccurate screens appeared during the process, but everything cleared up the instant data transfer was complete.

requires exceptionally careful planning. Furthermore, many programs can't handle certain characters the PC is capable of producing. Trying to move inadmissible data into a program that won't accept it can lead to weird results.

Your spreadsheet, for example, may not be too happy about setting text where it expects to see numbers and may well interpret some of those letters as commands, much to your chagrin. WordStor took SuperColc's vertical line character and converted it into a 3 by ignoring the high bit. PeochText's paragraph-marker character simply disappeared when it wes ported over to WordStor. A program with less sophisticated error trapping may burp and die when givan data it can't handletaking all the other partitions down with it like a house of cards.

Disk Follies

challenges to Memory/Shift. If you're using e program like WordStor, which sweps overlays into memory from disk. you heve to remembar to have the program disk in the proper drive. Fortunately, Memory/Shift is smart enough to remember which disk you had in the drive when last you used it-and demand that you nut it back.

Diskettes present a special series of

It keeps track by giving each disk a label-actually the filename of an empty and hidden file. In DOS 2.0 it's the 11 character DOS "volume label," but if you haven't christened the disk, Memory/Shift asks you to and lets you do it. In DOS 1.1.

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you get only eight cheracters to play with. and Memory/Shift adds the extension <L> without telling you.

The <1.> is an odd choice, since engla brackets are illegal file name characters in DOS 2.0. Though DOS 2.0 won't let you enter such a label, it doesn't seem to mind seeing it. Still, considering the new DOS manual's warning to give a new monicker to all files with newly-illegal cheracters in the file name, you have to hope you won't be playing with a time bomb when using old Memory/Shift-labeled DOS disks with DOS 2.0.

Of course, e disk copy of a given disk would carry the same label as the original. and Memory/Shift wouldn't be able to catch the problems if you used the copy by mistake. A more likely problem could be created by using one disk in more than one partition, which the program is quite will-

ing to let you do.

The manual does warn you not to use the same file in multiple partitions. because two different versions of it could wreak havoc with the disk's file allocation table. Fine, but if you're running two versions of WordStor or another program that creates a temporary file with a standard name (WORKING,TXT, say, or EDBACK-UP.\$\$\$), you could conceivably modify that file in two different partitions without even realizing it, ff that happened, the file could be irretrievably corrupted. When I tried it, WordStor was smart enough to recognize that something was rotten in the state of MEMSHIFT.\$\$\$, announced a "Fatal Error F28: Close Failure." dumped

PROGRAM may burp and die when given data it can't handle—taking all the other partitions down with it like a house of cards.

me back to DOS, end saved my original text. Other programs may not be so accommodating.

I did not check this program out at length on an XT. Suffice it to say that the one attempt I made at setting a program to run was unsuccessful. DOS couldn't find the program I wanted from the disk. It didn't have such problems before Memory/Shift was installed.

Let Me Count The Ways

Crashes I hasten to relterate are the

reel bene of a program like this. If the crash is severe enough-and it usually is-you will have to turn off the machine and wine out whatever is in memory in the other partitions. You may well discover that you have open files on some of the other disks-or worse.

ft's possible to exit e partition while the





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program there is writing a file to disk. If thet file gets written only partially, and a crash in another partition keeps you from going back to close the file, you can probably say goodbye to it. If the ruined file is an index to a rendom file, you'll have a very tough time indeed getting at your data. And if you're particularly unfortunate—for example, if you clobbered a file directory before it was fully rewritten you could lose the whole disk.

I deliberately courted a couple of these disasters, so I know they can happen. North American Business Systems says it's addressing the problem in versions currently being tested. In the meantime, it

wouldn't be a terrible idee to heve a copy of the file-recovering Norton Utilities around just in case.

Boot Hill

If a hang-up hasn't turned the system deaf to the plees of the keyboard, banging on Ctrl-Alt-Del will reboot a single partition without harming the others. To reboot the entire system, you use Left Shift-Ctrl-

CRASHES, I hasten to reiterate, are the real bane of a program like this.

Dei. If any other partitions are open, you then receive the warning: "Danger: other tasks active" and must confirm that you really want to reboot the whole machine.

In theory this helps you to avoid the damper of leaving partitions with potentially open disk files. In practice, many problems won! I let you reboot the current partition, so it's time for Boot Hill—turn ing the machine off and on egain. The partial seboot feature their has hange you worse. It's possible to reboot a single partition with a version of DOS thet you didn't begin with. Since Memoryhir retains only one version in memory, this could lead to no end of problems later.

Irreconcilable Differences

Memory/Shift happens to be incompatible with a wide variety of program to he documentation lists three the Memory Shift want to annot with Hopes and the more com II, WordVision, and ProKey. I tried them and it's turn, North American of the man dir is turn. North American the ProKey incompetibility can't be rectified. This is a shame, because is sorily incompetibility can't be rectified. This is a shame, because is sorily because it sorily because it sorily because it sorily more program.

But there's plenty of other software that won't run with Memory/Shift and may even cause a crash. Programs that don't stick to strict PC-DOS conventions are the prime suspects, but standard DOS



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programs that are copy-protected are also a major problem. My spot-check showed that Deadline and Asylum (which use propriatary operating systems) rafused to run, as did the copy-protected Time Monoger (which would otherwise be a perfect program for this type of system) and Visi-Word. One of the Norton Utilities worked fine until I was finished with it and returned to DOS, at which point the system want into a dead hang. The Memory/Shift manual points out that VisiColc may have trouble running from certain partitions. Leaving aside CP/M-86, p-System, and so on, it would be eminently safe to hazard a guess that there are plenty of other programs that won't run with Memory/Shift.

Copy-protection schemes fool Memory/Shift, but the program itself is copyprotected. Aside from the fact that you can't copy it to a hard disk, this is particularly annoying when you consider that you need a different copy for each version of DOS. True, once you load it, Memory/ Shift remains resident in memory until you turn your machine off, so you can sat your disk aside until your system crashes. And North American will sall you a backup-one per customer, please-for 14 bucks, which isn't all that avaricious. But the company can hardly complain about all those copy-protected programs that snaak around standard DOS and knock Memory/Shift down for the count.

Abundant Confusion

The manual for Memory/Shift is truly abysmeal. Avoiding important information in the name of "keeping things simple." it leaves the user high and dry with a few basic how-too and almost no details or whys. Many major points are undocumented. Typographical arrors assail the aye from evary pags in earlier versions.

THE MANUAL is truly abysmal.

The new ones have actually been proofread.

Confusion abounds. When you're through installing DOS on your Memory/ Shift disk, you're told to turn your machine off and on—a truly irritating activity if you'va got much memory at all—when a three-key reboot would serve the same purpose. There is no frank discussion about the problems of using copyprotacted software with Memory/Shift. But there is a glossary with such useful definitions as "EXECUTE KEY: Synonym for RETURN key" (perhaps they borrowed thair machine from the Mafia) and "MONOCHROME: Synonym for black and white" (a purist, the manual writer will defend against amber and green until his retina withers and dies). Despite an admonition to ask manufacturers of noncompatible programs to phone in with technical information, there's no phone number anywhere in the document.



CIRCLE 155 ON READER SERVICE CARD

I'm Not Lisa

To the people at North American Business Systems, Memory/Shift is clearly a big deal. They're marketing it hard, and they're hinting at powerful new edditions in future releases. The company has e policy of supplying the first upgrede free when you return your warranty cerd, and making subsequent updetes eveileble for \$14 eech, which seems reasonable enough.

But the mejor problem with Memory/ Shift is that it angenders ebsolutely no confidence, a particularly unsettling state of affairs for e program that has such e huge potential for disester. Much of its

basic dasign shows thoughtfulness—but dozens of details betray the kind of hasty, careless, it's-good-enough ettitude that helpad bring down the Amarican euto industry.

PROCEED with caution and make plenty of backups of your disks.

Whan e program gives you three options-Y, N, and Enter-it shouldn't allow you to enter "Moe." "Larry." or "Joe." And e technical writer should know that enybody who needs to be told thet e monitor is "The unit which looks like a TV tube and normally sits on top of the computer" has no business going anywhere near a program as fraught with peril as this one. And there should be no need for three different versions in a little over a month. If the program's reedy, release it; if not, beck to the compiler. With Memory/ Shift, you never get the feeling that the program will consistently do what it's supposed to do, time and time agein. It's precisely this feeling that separates the terrific software from the shelf-sitters.

Memory/Shift may well be biting off more then it can chew in its ettempt to integrate wildly disparete varieties of software by monkeying with PC-DOS. Still, it does things nothing alse I've seen can manage, end some moderately masochistic persons will probably be willing to teke advantage of its potential and live with the warts. To them I offer the following advice: Try the progrem out with back-up copies of the software and data you're planning to use with it. Think of ell the wevs you can cresh the systam, and see what heppens. If you do dacide to use it, start slowly: Work with two or three partitions et first rather then the full complement. Proceed with caution and make plenty of backups of your disks

Memory/Shift is not the Lisa, and it's not VisiOn. It's an interesting little progrem that could use a much better manuel, a lot more tasting, end e lot less hype. For Sey ou were expecting meybe the Goldberg Nine-Way Marvel, rube? /PC



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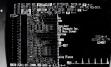
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VisiCalc was an innovative program. All by itself it probably sold more Applas than any other computer program axtant. Visi-Calc was also one of the first programs made available by IBM for the PC.

The people who designed VisiColc spant a couple of years doing extensive research and development before finally releasing a product called TK/Solver, which is now available for the PC. In many aways TK/Solver may be considered an extension of the original VisiColc concept. It is not a spreadsheet program, but ather an equation solver program for angineers, scientists, and other professions.

Suppose you were designing a new machine. In this process you would frequently have to select between engineering advantages and manufacturing economies, necassary tradeoffs in the search for a cost-effective and useful machine. TKiSolver is designed to make that selections are the search of the

tion process as simple as possible.

When you first run TK!Solver the

screen displays a blank variable sheet and rule sheet. The variable sheet will contain descriptions of the variables (input end output) used to construct the model. On the lower part of the screen the rule sheet describes the interactions between the variables.

Once you fill in the relationships, TK!Solver takes over. As in VisiColc, you push the ! kay to tell TK!Solver to solve the equations.

Let me present a rather involved axample illustrating the capabilities of TK!Solver.

Suppose I am considering buying a bouse. If sits a twp a group of lunctions that describe the relationship between interest retes, duration of the mortgage, down psymant, and monthly and total psymants. Figure 1 shows how the variable, ruie, and unit sheets might be set up. I pressed that I key and TR/Solver found values for the output variables (see Figure 2). My monthly payments would be \$823.31.

I movad tha cursor down to the interest rate line and changed 16.5 percent to 15.5 percant. I recalculated, and found that monthly payments had dropped to \$587.03 (see Figure 3). So far any spreadsheet could do these tasks, although TK!Solver makes it easier to sat up the

functional relationships.

As a next step, I blanked out the total house price and insteed asked: "if I can only afford to psy \$450 per month, with a down peymant of \$20,000, what house can I afford?" Apparently, the house should cost about \$54.500 (see Fisure 4).

Now, I want to consider a particular house, which costs \$85,000. What down payment would be required to meet my monthly payments of \$450? Apparently a \$30.504 down paymant (see Figure 5).

Since \$30,000 is more money than I could pay all at once, I decided to raise the monthly peyments to \$550; running the changed model (see Figure 6), I found the naw down payment was only \$22,838.

If you aren't careful, it can be easy to specify the values of too meny items, at which point the model no longer has e solution. Figure 7 shows the problem of an overspecified model. The > signs point to error conditions where TKISolver found equations with no solutions.

When TK/Solver cannot solve equations directly, it uses a method called "iterative solution." An iterative solution is performed by guassing the correct value (in the case for interest rate) and then moving the velue around until all of the equetions are satisfied. The manual is a bit sketchy on what algorithms TK/Solver uses for the iteration method, but the finel answers I recavied wave correct answers I recavied wave correct. You can see that the big advantage to TX/SiSdver is that variables are not fixed as input or output. This is unlike BASIC, where an equation, such as Y = 5X works in only one direction: the BASIC instruction will take the value of X amultiply by 5 (sep Y lnstead, in TX/SiStver, Y = 5*X means that X and Y are related by the fact that Y is *times as big as X. If you set X to 10, then Y is found to be 50. If you set X to 10, then Y is found to be 50. If you set X to 10, then Y is 10 found to be 50. If you set X to 10, then Y

As a last exercise. I set up a list of values for house prices, ranging from \$2.5 c. anging from \$2.5 c.

The advantages of TKSolver when compared with a spreadshest are maniloid. The most obvious advantage is that equations are treated the way people write them and think of them. An equation is fundamentally a neltitionship, not a directive to the computer to perform an operation. Further, equations use names for the variables, and units of measure [if change the displayed unit of measure [if payments, for example], the displayed values will change eccordinally.

AN EQUATION is fundamentally a relationship, not a directive to the computer to perform an operation.

If you wish to see what happens as a variable changes, you can also define a list of values for TK/Solver. It will run through the selections, and display the results on the screen. TK/Solver also contains a rather crude plotting program which uses asterisks (*) to display the values found during iteration.

Figure 1: The variable, rule, and unit sheets for the mortgage model to be run by TKISolver.



Figure 2: After the ! key is pressed to solve the mortgage model, the values of unspecified variables appear in the output column.







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Setting up a model is not a trivial task. You need to specify the variables, the relationships, and the units of measure. The people at Software Arts are hoping that engineers and scientists will work with them to create packages of models that can be loaded by TK!Solver. The first such package is a Mechanical Engineering TK!SolverPak, which I had the opportunity to play with, ft contained a number of routines and a brief manual describing them. These included bending of an elastic beam, a cantilever analysis, cylindrical heat transfer, fluid flow in pipes, and a hydraulic system analysis/design program.

$T_{\it HE\,PROGRAM}$ comes with an enormous assortment of mathematical formulas.

The mechanical engineering models were quite complex, and they point up the usefulness of TK!Solver to a working engineer. It's easy anough to look up the formulas and plug in the appropriate values for a calculation. Doing this for a number of different parameters and changing the desired outputs is another matter entirely. For example, you solve the problem: given a nine, find its heat transfer; then you turn around and try and figure out how to describe the pipe given a necessary rate of heat transfer. But that is another matter entirely. Commonly, this involves hours spent modifying and remodifying a program, or worse yet, bending over a calculator. TK!Solver excels in reducing the drudgery of those tasks.

The program comes with an enormous assortment of mathematical formulas (circular functions, net present value, polynomials, dot products, etc.) that can handle most common tasks. There is also a facility with which you can describe your own, more complex functions.

As far as solutions go, TK!Solver can iteratively solve most well-defined problems. It will perform direct solutions only on linear relationships or relationships involving defined inverse functions, such as arcsin. From a user's standpoint, the

Figure 3: The mortgage model is recalculated after the interest rate is reduced to 15.5



Figure 4: TK!Solver finds the maximum price for a house that could be purchased with a down payment of \$20,000 and monthly payments of \$450.



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Figure 7: A model connot be solved if too many variables are specified in the input column. When this problem occurs, a > symbol appears in the far left column to indicate the unsolvoble genetians and irreconciloble variables.



only differences between iterative and direct solution is that iterative solutions take a bit longer and allow room for error. If you're concerned about the extent of arror possible in a calculation, you can examine the comparison tolerance for iterative solutions on TK/Solver's Globals Sheet.

I encountered a few problems with the program. When I ran the mortgage program I noticad that the value of 30 years in variable n had apparently turned into 29.99999. Even moving back to tha call and reentering the value had no effect on the number displayed.

As must be done in writing any computer program, TK/Solver's authors had to decide what precision value to use. For reasons of spead thay used single precision (12 digits); the program has no provision for double-precision numbers or using the capabilities of an 8087 floating point processor.

One thing that electrical engineers will sorely miss is working with complex numbers. TKISolver only can deal with real numbers, although polar notation can be used if you specify all of the complex arithmetic as rules. Some of the mechanical engineering problems in the TKISolverPok ware done in this manner, resulting in a loss of the model's comprehensibility.

Finally, TK!Solver has the same bugs that VisiCalc has due to the copy protection scheme usad by Software Arts. Pressing the Break key after you exit from the program can have disastrous effects. I suggest rebooting upon completion, even though the program returns to PC-DOS.

The user interface to TK!Solver is almost identical to VisiCalc. The primary difference lies in the need to manipulate a number of sheets. This is not a problem thanks to the windowing they use.

THE ONLY
differences between
iterative and direct
solution is that iterative
solutions take a bit
longer and allow room
for error.

There are no formatting commands. Cells are displayed as numbers with optional dacimal point, or, if necessary, in scientific notation. Similarly, you can't really generate a business report, but that function is not in the spirit of the pro-

am. It is vary surprising that a more





advanced user interface was not used. You still have the / key command, which leaves you looking at a menu that consists of only seven letters—abbreviations that may or may not make sense. As with Visi-Calc, error messages are usually no more than a beep from the computer. Except for left and right cursor motion, the PC's function keys are not used in formula or text editing, leaving you with backspace delete as the only welting command.

In fact, all of the menus were single letter menus of the VisiCalc variety, with no way to get a more useful summary of available choices. In the same vein, I spent some 20 minutes trying to figure out why I had received an error message while trying to create the figures for this article. I compute beeped, and some > symbols appeared in the status column. Moving to the status column brought me this far from the informative message. "> error" |

In an attempt to increase the friendliness, TK!Solver does have Help messages. Pressing? at any juncture places you in the general Help subroutine, which then asks you for a topic. There is no simple way to find out what a menu means. When you ask for Help with respect to a topic, the program will require about 30 seconds to display a wordy, not very useful, Help message (see Figure 10). In some cases the Help message were totally unrelated to the Help item 1 had requested.

The user's manual is an attractive IBMsized looseleaf with a number of useful illustrations. Some of its verbiage is a bit confusing, but the tutorial is a readable introduction, although insufficient for advanced use.

A S WITH VisiCalc, error messages are usually no more than a beep from the computer.

It looks as if the authors at Software Arts have taken lessons from IBA mainframe writers. Consider this example from page II-23: "The List Sheet contains a table of all lists created in the program. A list is a set of values assigned to positional element numbers." That's all there is to the

Figure 9. The variable sheet is automatically solved five times, giving results for each of the values on the list of house prices.



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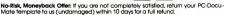
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Figure 10: The Help screens of TK! Solver take a long time to appear and are more wordy than useful.



discussion of lists. I still don't know how to get a printout of the results when using a list of values.

I estimate that if you are willing to bread and spend on the order of 20 hours to read and reread the user's manual, it will begin to the make sense. Then's no escape from this selfort. Even if you use a TKSolverPok you will need to understand why errors occur and how to fix them, which means you will have to plow through the manual anyway.

I have two major complaints with

I have two major complaints with TKSolver. First, the program is copy protected. This means catastrophes can occur to the diskette's physical media and you cannot run TKSolver of a hard disk. The program uses overlays, so it would speed up amazingly if it could be run under a RAM-disk or hard disk.

Since TK!Solver runs under PC-DOS, data files, at least, can be put on a hard disk and RAM-disk. I ran TK!Solver under PC-DOS 2.0 with no ill effects.

Secondly, the program has no graphics capabilities. One thing that scientists and engineers have in common with business and home users is a desire to see results graphically. The character graphics supported by TK!Solver are inadequate for all but the crudest comparisons.

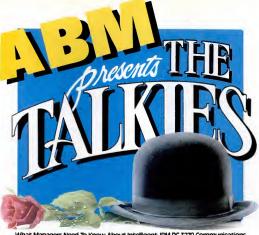
I F YOU ARE
willing to spend 20
hours to read and reread
the user's manual, it
will begin to make
sense.

TK!Solver does allow you to send data to a DIF file, and some programs are available that convert DIF data into graphics. But this is not as interactive as a program that supports graphics internally.

My impression of TK!Solver has PC MAGAZINE 498 SEPTEMBER 1983 changed radically since I began using it. At first I was distinctly disappointed with the program. It did not seem as innovative as would have expected from a trailblazing company such as Software Arts.

On the other hand, after using it for a while. Hound it to be a venstille tool. Engineers and scientists who have spent their time coaxing BASIC or VisiColo to solve equations would be better off with TX/Solver. Even home users would find it has obvious advantages (as seen in the mortgage model in my example), although the program's cost may be harder to justify in a household budget.

My biggest disappointment is with the user interface. To operate their program you virtually have to sit with the user's manual on your lap, unless you use TK'Solver in your work constantly. The error messages and menus are pitful. If you begin with a TK'Solver's or a completed model, then this may not be such a problem. The final process of plugging numbers into a completed model is very simple, and quite rewarding. /PC



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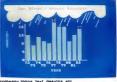
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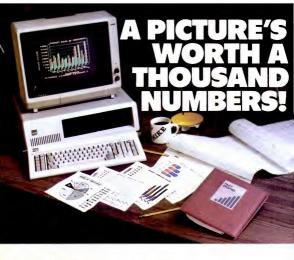
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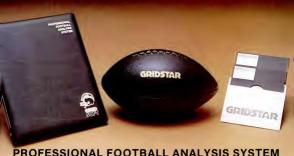
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The popularity of this summer's hit movie Wor Gomes, which stars a talking computer, has people talking about speech synthesis. From the moment in Wor Gomes when high school student David Lightman turns on the speaker to show his girl friend lennifer how his computer talks.

the computer takes on human qualities. But no mention of sneech synthesis is made at all in the movie. The audience accepts quite naturally and quietly that a computer called Joshua can talk. After years of viewing them on television and in the movies most of us accept talking computers as fact. Actually, it's only quite out of the laboratory and experimental stages. Two speech synthesizers, now available to the consumer at a reasonable price, are reviewed here: the Echo Speech Synthesizer (General Purpose Unit) and the Speech Master.

Speech synthesis exploded onto the scene in the commercial marketplace in 1978 with the success of Texas Instruments' Speak 'n Spell, All of a sudden, people were aware that machines were talking for a very reasonable price.



In the current hit movie, War Games, David ck) shows his girl friend, Jennifer (Ally Sheedy), how his computer Jashua talks.

something like a tape recorder, with all the words stored inside of the unit. In fact, it doesn't work like that at all.

Speech synthesis simply means the generation of speech by computers, such chown own. Wast actually happens is that a computer models or mimics the complex process of utering words—the sounds from our vocal cords, combined with the air and noise passing up our throats, through our models or up to the speech is achieved in much the same way were speech is achieved in much the same way were supported to the same way to the same w

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A talking computer may be cute, but what can you do with ii? Speech synthesis is more than a passing fad, a novelty, or something just for games. While synthesizing speech has been used for such esoteric and varied uses from communicating with dolphins to enhancing X-rated software, its practical applications are diverse and impressive.

Some of the more common applications for speech synthesis at the present time include the following:

- Making computers accessible to blind people. Speech synthesis allows the blind to "read" computer output otherwise available only from the screen or printed copy. This is tied closely to word processing as well as computer programming for the blind. There are also programs that can read to the blind using sneech synthesis.
- Mute people can now use an IBM PC, equipped with a speech synthesizer as a whicle to speak.
- Education is one of the most widespread applications for speech synthesis.
 A talking computer can provide repetition, reinforcement, corrections, and encouragement, all in an atmosphere of
 - Business and industry are using speech synthesis for telephone touch-tone checking of inventory status and sales reports. Training programs lend themselves well to employees working with a talking computer. Industry is already using the sophisticated process of voice synthesis combined with voice recognition (i.e., the computer accepting verbal commands).

Figure 1: How speech synthesis works (text to speech). TYPE IN: PC MAGAZINE THE MICROPROCESSOR THE SEQUENCE THE BRAINS IS RECOGNIZED RECINS THE PROCESS OF AMBIGUITIES SPEECH SYNTHESIS LETTER TO SOUND RULES DURATIONS AND THE LETTER AND WORD SOUNDS TIMING, ALONG WITH BASIC SOUND ARE SHAPED FREQUENCY, ARE AND MOLDED PRONOUNCING DICTIONARY PHONETIC SEQUENCE THE CREECE CHIP NOW MODELS GENERATED OR MIMICS THE VOCAL TRACT Pê Sê Ma-sa-zên III SOUNDS ARE CENERATED. THE SPEAKER THE WORDS BUT ACTUALLY ONLY 6 PRODUCES PHONEMES ARE LISED WITH ARE TRANSFORMED THE WORDS SOME LISED MORE THAN BACK TO SIGNALS FOR THE SPEAKER

Talking Screen Text Writer

One of the most exciting and successful educational programs making use of speech synthesis is taking place in Tempe, Arizona. Dr. Terri Rosegrant, a professor at Arizona State, has developed a word processing program for children, which uses speech synthesis.

The program, called Tolking Screen Text Writer, is designed for ages 3 to 9, and has proven to be an effective learning tool for the learning disabled, educable retarded, and remedial readers. "Normal children tend to learn faster with this program, too," says Rosegrant.

Using an Echo Speech Synthesizer, Rosegrant's program allows a child to work at a comfortable, individual pace, while the computer repeats each letter and word typed. The child then sees and hears the words. Whatever a child types in can be saved on a disk and later reread, when the computer again says each word, flasbing it on the screen.

Rosegrant has field-tested her progran

for a yeer on Apple computers, with much succass. The program is currently being adapted to the IBM PC. Rosegrent cowrote the program with Russall Cooper in assembled BASIC. Rosegrant firmly believes that "synthesized speech is absolutely required for good educational software."

Synihesized speech is absolutely required for good educational software.

A Long Time Coming

Speech synthesis can be treced back to the late 1700s whan a Russian used acoustic resonators to synthesize vowel sounds. A hundred years later, Alexander Graham Ball produced a crudely constructed model of tha vocal treet, which reproduced yowal sounds and even e few words.

It wean't until tha 1930s that Bell Labortotories invanted one of the first speech synthesizers thet could run on electricity. The device was called a Voice Operation Demonstretor (VODER). At thet point, synthesized speech was expensive and bed e long wey to go before the talking contraptions could be operated at a reasonable cost and without a great deal of

For the past two decades the Department of Defense has been working on something called the VOCODER Project. This project digitizes, analyzes, compresses, and extracts speech paremeters, which are transmitted over phone lines and then reconstructed. Meny of the current speech synthesis techniques bew come out of the VOCODER Project.

Today there are diffarent ways to ganerete speech with a computer. Most of thase procadures consume a great deal of memory, except for a process called Linear Predictiva Coding (LPC). To understand how LPC works, it belps to take a brief look et other weys to synthesize speech.

One of the most effective alternatives is a process known as digitized speech. In this process, the size of speech signals is measured every 25 milliseconds. Those measurements ere saved in mamory as digitel numbers. Such speech is reproduced by convarting the digitel numbers back to signals, which are then sent to e sneeker.

Digitized speech produces excallant quality speech, but it uses up incredible emounts of memory, 8000 bytes per second end up.

Two other methods of speech synthissis that reduce the memory requirements while still producing good quelity speech are delte moduletion and pulsa coda moduletion. They use a technique similar to digitized speech, except that the process compresses speech. The memory drain is cut by half. The Supertalker board for the Apple end Fidelity Electronics' Chess Chollenger games are examples of this expresses.

In waveform compression, another process of generating speech, each different sound signel is seved only once and called up as needed. The sounds can then be modified to fit into the proper usage and sentence structure required.

The best example of weveform compression is Netionel Semiconductor's Digitalker chip, which is being used for such products es the telking checkout counter et the grocery store.

And now we come back to LPC, which is quite different from the other methods, and usas very little memory. The other methods ectuelly save the speech signal in digital mamory, with varying degrees of compression. The signels are then "pleved back" egain for speech.

Through LPC, insteed of dupliceting the speech signed, the humen vocal tract is methemetically modeled. Sounds are than generated by e signal source, which is similar to the vocal chords. Languaga rules are programmed in so the generated sounds reproduce speech. The rest of the vocal tract is represented by e speciel type of mathematical filter that shepes sounds and gives them their various characteristics.

The secret to using such e small amount of memory lies in the phonetic encoding of words with LPC. English contains fewar than 50 basic phonemes (word sounds), from which all of our speech is

By stringing phonemes together, any word in English (or eny other lenguage, for thet mettar) can be produced. So, in LPC only the phonemes themselves need to be stored. They ere used over and over egein in severel hundred different combinations for synthasized speech. Words are simply typed in on the keyboard and then spoken by tha computer. The procass is known as text-to-speech.

Because text-to-speech uses word sounds in so many different combinations, certain words need to be "misspelled" or, to put it more accurately, spelled phonetically, to make them sound right. It is because of the need for phonatic spelling that taxt-to-speech doesn't have the sound quelity of other typas of speech synthesis. Nor does it have the custom vocabuleries known es fixed speech.

The edvantoges of LPC are twofold: Speech is intalligible and the amount of memory needad is as little as 150 bytes per second. One of the best benefits of LPC is that it allows unlimited speech, Just about eny word goes, except for the ones that need to be spelled phonetically to get them to sound right.

Through LPC you can elso bave perencoded fixed speech, which is setually a
custom vocabulary. A set list of words is
extually stored in ROM or one disk. While
the number of words is usually limited, ell
of those words will come out sounding
perfectly clear, without acception. The
two programs reviewed hare both offer
fixed speech: the Speech Master has 147
words, while the Echo has close to 700
words.

pigitized speech produces excellent quality speech, but it uses up incredible amounts of memory.

The quality of fixed speech is much better than thet of text-to-speach, but fixed speech uses more memory. Fixed speech through LPC saps about 150 to 200 bytes per word and needs to be stored somewhere. So the more words you have (or went) the more storege capacity (in ROM or on a disk) you need.

Text-to-speech is the most commonly

used option for personal computers because it uses so little memory and offers unlimited speech. It has, however, one considerable drawback: inferior sound quality.

Both Speech Master and Echo use textto-speech and both sound somewhat machinelike or robotic. The Speech Master sounds much more like a machine than does Echo. Dr. Hissahi Wakita, president of the Santa Barbara Speech Technology Laboratory in Californis, feels that text-out speech lacks "naturalness." That naturalness Is what makes the difference between feeling you're working with e machine and with something more personal. He explains that the machine-like voice is a result of limited memory environment, and with the cost of memory decreasing, better, more natural sounding speech synthesis will become available.

The fixed speech has e more human sound to it because the words are not constructed as they are needed. They are

pulled up from storage as encoded words. An interesting aside: Speech Master's fixed speech voice was mele, and Echo's was female.

Both Echo and Speech Mester can give your PC a voice. Both operate using the text-to-speech technology and both include the fixed-speech option. While similar in certain ways, their individual approaches are totally different. Speech Master comes on a board, which is installed in an expansion slot on the PC. The Echo is a separate, quite small box that is attached to the computer through a

serial interface.
The differences don't stop there. Tecmar's Speech Master uses a VOTRAY SC OI speech chip, while Street Electronics' Echo uses the Texas Instruments 5220 speech chip. The Speech Master costs twice as much as the Echo. The Echo has been around on the Apple for 3 yeers (under the name Echo II), so some refinement has taken plece before this version was released.

SPEECH Master's fixed speech voice was male, and Echo's was female.

Using the Speech Master
The Speech Master comes with a demo

disk and a 22-page menuel. Tecmar continues to release manuals that do a good job explaining installation but offer very little information in understandable English about actually using the product. For whatever reason, it provides two pages at the end of the manual for notes, followed by a "Product Comment Form."

Installing the Speech Master is easy, provided opening up your PC doesn't horrify you to begin with. However, once you close it back up you'll discover that the tiny round, black object on the back of the board is a speaker, which is totally inade-

What's even worse is that the speakar is mounted at the wrong end of the board. This means that the speaker is nowhere near the speaker openings at the front of

Figure 2: This is the list of fixed words for the Speech Moster. Trying to put together different combinations of words for programs you write will be difficult because of the limited choice.

ona	two	three	four
five	six	seven	eight
nine	ten	aleven	twelva
thirteen	fourteen	fifteen	sixteen
seventeen	eighteen	nineteen	twenty
thirty	forty	fifty	sixty
seventy	eighty	ninety	hundred
thousand	million	zero	a
Ь	С	d	6
f	8	h	i
}	k	1	m
n	0	р	q
1	5	t	u
v	w	X	y
z	again	ampere	and
at	cancel	case	cent
400Hz tone	80Hz tona	20ms silence	160ms silenc
320ms silence	centi	check	comma
control	danger	degree	dollar
down	equal	SLLOL	feet
flow	fuel	gallon	go
gram	great	greater	have
high	highar	hour	in
inches	is	it	kilo
left	less	lesser	limit
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your PC. Tecmar does provide the option of an RCA phono jack on the board. Plan to use an external speaker, because even with the volume control, the Speech Master board won't be able to generate enough sound from inside your PC.

I went to Radio Shack and bought an 8-ohm speaker/amplifier (which required a 9-oil battery) and a cable for less than \$20. The Speach Master manual does explain how to switch over to an external speaker. All you need to do is flip switch? open on SWI and then position the speaker jumper to J2. Installing the speaker was effortless, but it required at rip to buy the speaker, reopening the PC, and additional expenses.

What the Speech Master manual doesn't do very well is explain how to use the Speech Master. The four sample programs in the manual are pitifully insufficient, to say the least. After some experimentation, and help from a technical expert, I was able to use Speech Master to

get my PC talking.

The initial problem I had was with the demo disk. There wasn't any documentation with the demo disk and the manual provided no clues either. I later discovered that by listing the Tolk program, I could compel it to explain how to run the

Demo and Tolk programs.

To run the Demo and Tolk programs
from the Speech Master support software

package follow these steps: 1) Load DOS 1.1

 With the DEMO disk in the B Drive, type B:ENGLISH. This puts an overlay in RAM, which then allows the demo programs to work.

3) Then type in BASICA.

4) Remove DOS from the A Drive and replace It with the Tecmar Demo disk.
5) Then type LOAD DEMO.

TECMAR
plans to release a model
with more expansion
modules of fixed speech
to increase the number
of custom words
angulable

to increase the number of custom words available.

Once you've followed these steps, Tecmar's Speech Master gives a little speech. This is your first exposure to a strange lit.

tle voice with a pronounced accent. Next you can load and run Talk, which allows

you to type in anything you want the computer to say.

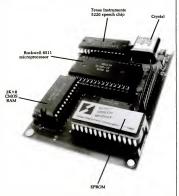
A buffer built in to the Speech Master allows you to type in up to three lines the speaking ceases. The novelty of typing in words for the Speech Master to speak wears off relatively feat, which leads to the question: "How do I put speech into the

programs I'm writing?"
It is possible to enhance programs you write with speech synthesis, but it is not all the test with the Tecmar board.
Speech Mester allows you to do programming with the fixed speech or text-to-speech. With fixed speech you are limited to 147 words (see Figure 2), while with text-to-speech, there is no limit.

Tecmar plans to release a model with more expansion modules of fixed speech to increase the number of custom words available. The board now comes with the first two modules filled—that's where the 147 words are—and has six expansion slots for future modules.

In using the Speech Master manual to write programs, the nontechnical PC own-

Figure 3: Echo's speech synthesis board. The crystal generotes the clock frequency for the microprocessor. The Rockwell ES11 microprocessor is the brains of the board. The XK-8 CMGS RAM consists the buffer of opportunitely 1700 chorecter. The buffer oil to go to go as neveral lines of text to be spoken without longs on words. The EPROM is where the octival text-to-speech program resides in RK-8 fixM.



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DISPLAY

P.O. Box 312 Flourtown, Pa 19031 (215) 836-7100 ar can easily get lost. Such a lack of clear, easy-to-understand instructions points toward a real need for a tutorial for the firsttime user.

Producing speech with the Speech Master requires setting the base port address and then using either the fixed vocabulary in ROM or the text-to-speech synthesis process on the VOTRAX chip. You then send the word or phoneme code to the selected synthesizer for the actual speech synthesis to take place.

After having looked at how the demo programs were written, I wrote a simple program using the LPRINT statement to put speech into the programs I'm writing. The process wasn't quite as simple as it sounds. What it all boils down to is adding extra lines to your program to make it talk.

YOU CAN vary the pitch and tone and even make your PC sing.

I noticed two annoying distractions when using the Speech Master. The textto-speech voice was quick and chopy, and its Danish accant wore thin after awhile. Compared to the Echo, the Speech Master næeded many mora words spelled

Man-Machine Communication

Remember HAL, the lip-reading computer in Stanley Kubrick's 2001: A Space Odyssey? You're not the only one.

Dr. Hisashi Wakita, president of the Speech Technology Laboratory in Santa Barhan, California, recently discussed the future of speech synthesis with author Bil. Alveraza. Dr. Wakita is noted for his indepth work and research over the past 20 years in many areas of speech, including voice synthesis and voice recognition. He is currently involved in a research project

on automatic speech recognition.

Alvernaz: What does the future hold for speech synthesis?

Wakita: Speech synthesis and recognition will play an important role in manmachine communication. In other words, you speak to the computer, it then talks to you, ond it does what you asked it to do.

Alvernaz: Do you mean a computer similar to the H.A.L. 9000 in the movie 2001: A Spoce Odyssey? Wakita: Yes, but as far as such a speech

understanding system for conversational speech is concerned, it probably won't happen this century. A computer that advanced is beyond the turn of the century. In the meantime, though, there will continue to be developments and step-by-step improvements in speech synthesis and recognition leading toward that

goal.

Alvernaz: Is much work being done right now on speech recognition?

Wakita: Yes, quite actively. In fact, speech recognition devices are currently being used in industry and are available from such companies as NEC. Verbex, Votan and Inter-State Electronics.

Alvernaz: With voice recognition do the machines actually understand what you say? Wakita: Yes, but in a very primitive

sense. Many of them just accept verbal commands. Most of the voice recognition devices must be fine tuned to your voice before use.

Alvernaz: Is the vocabulary limited with voice recognition?

Wakita: Yes, very much so. Right now the recognizable vocabulary for voice recognition only includes several hundred words.

Alvernaz: So, as you said, we're beading toward machines which not only talk, but understand what we're saying? Wakita: Yes. We are awaiting the arriv-

al of the day when we can have computers speaking to us in measured tones of reassuring condescension like the H.A.L. 9000 in 2001. -B.A.

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Figure 4: A list of fixed speech words for the Echo. The words ore clearly spoken in a feeminine voice. The variety of words to choose from means that your own programs, which you customize with synthesied speech, should be foirly complete from a talking computer standardoint.

a	able	about	above
across	act	action	add
addition	after	again	against
ago	air	alieus	all
almost	along	already	also
althuugh	always	am	American
among	ampersand	an	and
animal	another	answer	any
anything	apple	aqua	are
area	around	arrow	as
asked	assume	at	available
away	ь	back	became
because	become	been	before
began	behind	being	bell
better	between	big	billion
black	blue	board	body
book	both	bottom	boy
boys	brought	brown	business
but	by	c	call
called	calling	came	can
cannot	car	card	case
cassette	cent	center	certain
change	check	children	choice
church	circle	city	clear
clock	close	closed	code
cold	college	color	column
come	comma	command	company
complete	completed	computer	connected
console	controller	correct	could
country	course	cut	cvan
d	dark	data	day
death	development	device	did
different	disk drive	diskette	divide
division	do	does	dog
doing	dollar	done	door
dos	double	down	draw
drawing	during	6	each
eariv	earth	eat	Echo
economic	eighteen	eighty	either
electronics	eieven	eise	end
English	enough	enter	tidae
escape	even	ever	every
exactly	example	experience	ſ
face	fact	family	far
fast	lather	federal	feel
feet	felt	lew	field

phonetically to sound correct. With speech synthesis, it is so much nicer to have a word spelled properly and then pronounced correctly.

Something to Talk About

Milo Street, president and founder of Street Electronics, did his homework and also learned from his 3 years of marketing the Echo II for Apple computers. He has produced a real winner with the Echo Speech Synthesizer (General Purpose Unit).

The Echo is not only affordable, but it wraps up a very complex process in a simple little charcoal colored box smaller than a box of diskettes. All you do is plug it in and you're ready to go!

And if that news isn't good enough, the Echo is easy to use. The documentation comes in the form of a manual with 50 readable pages and a helpful tutorial. Using the Echo is simple. You buy it, take it home, and connect it to your PC through the serial port.

If there are any drawbacks to the Echo, one might be the serial connection. If you currently use your serial port for a printer, you'll have to switch cable connections every time you want the computer to talk instead of print, or vice-verse. However, you don't have to open up the PC to use Echo which is a blessing considering other demands on the PC's limited supply of exements of local printers.

The Echo has an on/off switch. A red light lets you know when it is on, a useful letture that will keep you from leaving the unit turned on all night. Every time you turn on the Echo, it responds with "Echo ready." To generate speech, all you need to do is use an IPRINT statement while in BASICO BASICA. The manual provides a simple 11-line program for typing in words to be spoken, similar to the Speech Master's Tolk oveream.

In its Apple version, Street Electronics kept the procedures for speech synthesis simple. And, wisely, that philosophy has been continued with the Echo.

Ease of use is an understatement and just part of what makes using the Echo so sweet. The Echo has so many easy-to-use options that you might never use them all. However, it's nice to know that you can speed up or slow down the Echo's speech. You can also vary the pitch and tone and even make your PC sing. The system ranges over nearly there octavery.

The text-to-speech process can be manipulated to sound quite human. The actual voice of the Echo has a soft, friendly tone, without much of an accent at all.

At the heart of the Echo is the Texas Instruments' 5220 speech chip. Combined with a Rockwell 6511 microprocessor and a speaker/amplifier, it's an impressive compact package (see Figure 3).

THE VOICE of the Echo has a soft, friendly tone to it, without much of an accent at all.

The manual for the Echo starts out with a description of the product and an installation section that is very helpful. It answers the questions you'll most likely have on your mind, and informs you about everything you need to know about speech synthesis and how it relates to making your PC talk. The manual assumes that you want to know as much as possible, and it does a good job of explaining in plain Enailsh.

The Echo has a built in buffer that allows you to type up to 1700 characters for your PC to speak at one time. This translates into much more than the Speech Master's buffer of only three lines.

The tutoriol is outstonding. It begins: While typing in phrases for the Echo to speed, you map how come cores as posed, you map how come cores of the period
The Echo works so well, it comes close to perfection. The tutorial goes on to explain Echo fixed speech words (con't).

64h

fifteen	fifth	fifty	figure
find	fine	finish	finished
fire	first	fish	fit
following	food	form	forty
found	fourteen	fourth	fraction
free	from	front	future
8	game	gave	general
get	getting	give	given
go	God	going	good
good work	goodbye	got	government
gray	great	green	ground
group	grow	guess	h
had	half	hand	hard
has	have	having	he
he is	head	heard	held
hello	help	her	here
high	higher	him	himself
his	history	hit	home
hour	house	how	however
human	hundred	hurry	1.
I em	I win	idea	Identification
if	important	ln .	inch
inches	individual	information	inside
instruction	interest	into	is
it	it is	Itself	1
job	John	joystick	just
k	keep	key	keyboard
kind	knew	know	known
1	land .	large	larger
largest	laser	last	later
law	learn	learned	least
leave	left	less	let
letter	life	light	like
line	little	live	lived
living	load	loading	local
long	look	looked	looking
low	lower	m ·	made
magenta	major	make	making
man	many	matter	may
me .	mean	medium	member
memory	men	message /	middle
might	mile	mlllion	mind
minute	miss	module -	moment
money	monitor	more	morning
most	mother	move	Mr
Mrs	Ms	much .	· multiplication

Echo fixed speech words (con't).

multiply	must	my	n
nama	national	near	neat
need	negative	never	new
next	nice try	night	nineteen
ninety	BO	not	nothing
now	number	numarator	. 0
o'clock	of	off	office
often	old	on	once
only	open	10	orange
order	other	out	over
own	р	paddle	page
papar	part	partner	past
people	per	perhaps	period
personal	photo	picture	pink
place	plant	play	please
point	political	position	positive
possible	power	present	presidant
press	print	printer	probably
problem	program	proud	public
purple	put	putting	q
question	quite	r	ram
random	rather	ray	ready
ready to	real	really	reason
start	recordar	red	reed
refer	remember	reset	rest
result	return	rewind	right
ringing	rom	moon	round
row	run	8	said
same	save	saving	saw
say	says	school	screen
second	seconds	seemed	seems
seen	seiect	select one of the following	sense
sentence	service	set	seventeer
seventy	several	shall	shape
she	she is	shift	short
shorter	should	show	shown
side	since	sixteen	sixty
slot	slow	smail	smailer
smallest	so	social	society
some	something	sometime	soon
sorry	sound	south	space
speak	speakeasy	speaker	special
speech	speil	sport	squara
start	started	state	step
still	stop	story	street

that words like typewriter need to be spelled as two words (type and then writer). A word like robot needs to be spelled rowbot.

SPEECH synthesis has yet to arrive at the point where every PC owner needs the talking computer option.

While you do need to misspell certain words, with the Echo this requirement is minimized. The promotionel brochure for the Echo states that it is 90 percent effective at pronouncing words, and 1 found this to be e reasonable statement.

The next section of the tutorial covers the commands that allow you to operate the Echo in different modes. The CrI key, combined with letters, is used to manipulate how the speech sounds or, as the manual refers to it, to activate different modes of the Echo.

By using a Ciri EE command, you can expand how the Echo speaks, meaning that the synthasized speech will be slower. You can compress or speed up the speech by using Cirl EC. You have the speech by using Cirl EC. You have the option of having the Echo pronounce each letter es you type it instead of saving each word. This is accomplished with Cirl EL. It for letter! To go back to having the commands is quite simple. The Cirl Ec commands is quite simple. The Cirl Ec commands is quite simple. The Cirl Circ compressed, E for expanded, and so forth.

The Echo will even pronounce all punctuation cheracters except spaces, line feeds, end carriage returns. Pitch can be adjusted to an incredible 63 different levels. If you should want robotlika speech, you can do that by putting in a flat oitch.

The tutorial doesn't end there. It goes on to actually show you more about how to use all of your newfound knowledge. The end of the section gives you more useful technical information and understandable explanations of the types of sounds represented by the phonema codes.

The six categories of phoneme codes are explained exceptionally well:

VOICED CONSONANTS AND UN-VOICED FRICATIVES: Eoch of the voiced consonants is created by vibrating your vocal cords. Place your fingertips ogainst your adom's apple and say The sensotion you feel with your fingertips is the vibration of the vocal cords. Controst this with the lock of sensotion which should result when you soy the unvoiced fricotive "sssssssss." The "s" sound is not produced by vibroting the vocol cords, but through friction, produced os oir flows over the vorious ports of the vocal troct.

The manual includes a sample phoneme vocabulary, plus the codes and commands necessary to manipulate the Echo. This section of the manual is extremely helpful as a quick reference. For the real beginners, there is even a section of the manual explaining how to get your PC up and running in BASIC or BASICA to use the Echo. There just isn't anything left out in the manual-all in only 50 pages. For those who do programming and want a more sophisticated voice from the Echo. Street Electronics offers fixed speech in a software package for an additional \$29.95. The voice is feminine and pleasing to the ear. The best news of all is that this diskette contains close to 700 words (see Figure 4), a more realistic number to work with than Speech Master's 147. To include fixed-speech words in your own programs, you need as many words as possibla for flexibility. And that flexibility is built in with Echo's additional 500 words

A special editor program or series of instructional prompts walls you through using the fixed speech disk. This works much more simply than Speech Master's fixed voice option does. With the Echo all you do is "pull" the words you want off the disk and store them in the program you're writing. The words will then be that, to be spoken, whenever, you command them to do so with the LPRINT statement.

The driver program, which puts the selected words on your program disk, uses

Echo fixed speech words (con't).

atudy	subtract	subtraction	such
sum	sun	supposed	sure
switch	synthesizer	system	t
table	taka	taken	teen
telephone	television	tell	ten
textalker	than	thank you	that
that is correct	that is right	the	their
them	thamsalves	then	thera
these	they	they are	thing
think	third	thirteen	thirty
this	those	though	thought
thousand	threw	through	thus
time	today	together	told
tone	took	top	torpedo
toward	trea	triangle	true
try	try again	turn	turnad
twelve	twenty	type	u
under	understand	Unitad States	until
up	upon	upper	us
use	used	using	usually
v	very	w	wait
want	wanted	war	was
water	way	we	we are
week	welcome	well	went
were	west	what	what was
whan	whare	whether	which
while	white	who	whole
whose	why	will	wind
with	within	without	word
work	working	world	would
x	V	vear	yetlow
ves	vet	you are	you win
young	your	Z	Zero

approximately 1K. Each word uses up roughly 150 bytes. The memory drain will add up quickly depending on bow many words you put in your program, but what's nice is that you can customize your programs, using fixed speech or text-tospeecb.

With fixed speech you have most of the can be combined to make a complete, rea-

same ontions as with text-to-speech. You can lower or raise the voice, and make it talk fast or slow. You can change the inflection and pitch to match the inflection of questions or statements of exclama-

The Echo and the fixed-speech disk

sonable package for anyone interested in making the PC talk. Having been around for 3 years now with Apple computers, Echo has numerous productive uses, rang-

PEECH added a sense of life. individuality, and uniqueness to our PC.

ing from Rosegrant's program to a word processing program for blind people. usiness and industry are using the Echo also. It's hard not to be impressed by bow well it works, bow simple it is to use, and at how reasonably it is priced.

Talking a Little Better A talking PC takes a little bit of getting

used to. There are two reasons for this. One is that the actual computer-generated volce, especially with text-to-speech, sounds strange. The other and more significant reason is that people do not speak as well as we should; we don't enunciate clearly.

Take, for example, the question, "How are you doing?" What we really say is, "How ve doin"?" When you type in "How are you doing?" that's exactly what the Echo or the Speech Master will say, and correctly, too. So, yes, it does sound different, but only because we chop off words as we speak. Think about it. Even "good night" is butchered to "ga-nite."

Speech synthesis has yet to arrive at the point where every PC owner needs the talking computer option. But there is a certain magic in listening to a computer named Josbus talk in War Games. After seeing the movie, my family felt some of

that magic. We noticed a personality change in our PC once it started talking. We knew it was only able to speak through a special technological process, in response to what we typed in on the keyboard, but somebow it seemed to be more than just a machine talking. Speech added a sense of life, individuality, and uniqueness to our PC. And for those of us who do quite a bit of programming, speech synthesis will continue to grow in importance, too.

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General Electric Information Services, a GE subsidiary, sells and services IBM PCs to encourage hookup to its mainframe databases.

GE'S \$10 Million

PC Connection

Ten million dollars buys a lot of PCs and XTs. And while General Electric Information Services (GEIS) Company executives are keeping their lips sealed about the exact number of IBM micros their \$10 million is buying, several things are certain.

For one, the GE/IBM agreement will speed the integration of microcomputers into the world's largest commercially available teleprocessing network. Further, new software developed to make such integration possible will prove useful to individual PC users who would like access to megacomputer capabilities. Third, the likelihood that many more businesses will be using IBM micros in their day-to-day operations is likely to stimulate development of more standajone software for the PC.

GEIS and the Micros

But let's take things step by step. First, what is GE Information Services, and why is it purchasing all those microcomputers from IBM?

The thriving company, based in the booming Washington, D.C. suburb of Rockville, Maryland, is a wholly-owned subsidiary of General Electric. In 1982, CE Information Services revenue topped Seon million. Through there "Supercenter"—In Rockville, Olici, and Amsternam-with 450 processing and communications computers, the company provides and the company of the compan

5.000 business clients around the world. The Rockville Supercenter, a meanment to high technology, is sel incongrament to high technology, is sel incongrahips just a short drive awey from GE's microcomputer products unit. The highsecurity facility has its own back-up gaerator to guard against power interruptions. It boasts a boat of Honeywell and IBM mainframes, tape drives, communications controllers, and processors, complet with thermo-bundingsays to mainclusters.

The GE/IBM macro-sized micro-deal is aimed at making massive central computing capacity available to users of personal computers. We want to make it easy for customers to do local processing and tie in with the mainframe, "explained Michael Olfee of the GE information Services Microcomputer Ventures unit. For a company like GE, which already maintains such a teleprocessing capability, the potential of micros is staggering. As Dr. Ruann E. Pengov, manager of marketing services

GE DECIDED
that the surest way to
capitalize on the
microcomputer potential
was to purchase micros
and market them to its

operation, predicted at the INTERFACE
'63 Conference earlier this year, "In 1986,
microcomputers will be in operation on
over 19 million desks worldwide, comnamed to over 8 million in 1983."

oum customers.

"The full benefit of microcomputers will not be realized until they are successfully integrated into an organization's dete-processing solutions," Pengov told ber audience. A key part of her company's mission is to persuade deta-processing managers that ignoring the potential of micros can be a costly mistake measured in a waste of processing power, time, and productivity.

GEIS promotes integration of microcomputers by helping build whet management-information systems (MIS) executives call data integrity. The GEIS system makes it relatively simple to upload data automatically from the micros to update

the mainframe.

According to Oile, all common program formats on be uploaded and manipulated on the book. For example, a certified public accounting firm could down-load information on the latest changes in tax rules from the GEIS mainframe to local databases, providing an added quelly factor. Or when a project involves interniate roccord the status of updated modules to that co-workers using other microcomputers will know when something hachanged, even if they had been unaware that someone was working on it.

Making Predictions Come True GE decided that the surest way to cap-

italize on the microcomputer potential was to purchese micros and market them to its own customers. The choice of which micro to buy wasn't obvious at first, recalled Steven P. Korn, the company's microcomputer products manager. Why here IBM? "It was a marketing decision based on IBM's credibility and presence in the marketialoc." Korn said.

GE Information Services is purchasing complete IBM systems, including IBM drives and IBM monitors. Because of legal and logistical problems, GE has been



The IBM 3081 Jurnishes the raw camputing power far the General Electric Information Services (GEIS) MARK 3000™ Service at the Rockville, Maryland Supercenter.



peratar at major console area manitaring service

reselling the hardware only in the United Stales and Canada so far, although some customers in Europe bave obtained their own PCs. Korn said. One company goal, as he described it, is "to find a way to deliver and maintain the equipment anywhere in the world." This capability would enable multinational clients to standardize their configurations around the globe, he said.

GE assembles, stages, tests, and installs the micros itself according to configurations specified by the customers. GE also accepts responsibility for total application support, including hardware maintenance. Further, the company is developing and markeling appropriate software. As Olfe put it, "We want to make it unnecessary for the ultimate end-user to shop down the street for missing pieces." To reinforce this concept, GE has begun marketing the Hayes Smartmodem, preferably bundled with the IBM hardware and GEoffered software.

Although the company markets only IBM micros, it has qualified the Apple II Plus and the Tandy TRS-80 Model II for use with the GE network. Clients have to acquire those brands on their own. In the future, the company will consider other machines (some more powerful than the Apple and Tandy models as well as some portables) for use with the system, Korn said. Evaluations of a number of portable units are being conducted this year to determine which portables will qualify for use with the GE teleprocessing network. Rating criteria will include ruggedness and reliability, how much of the IBM PC's functionality is preserved by the portable. and whether it will appeal to the endusers. Korn added that GE may simply qualify some portables (such as it now does with the Apples and TRS-80s), or it may arrange a mass purchase and resale deal similar to its arrangement with IBM "if there's enough (financial) margin in the hardware

Demonstrating the Micro/ Mainframe Link

For the end users, the marriage of micros to host allows communication between multiple siles within an organization. There's an old saying, "Do as I say, not as I do." GE is practicing what it preaches.

GE staff recently demonstrated a program called Pipeline, which is used by the company's sales representatives in the field. On a daily basis, field reps enter information about prospective customers into remote PCs. The field reps and their superiors use the data to assess the chances of completing a business arrangement and then to project revenues if a contract is signed with a new customer.

A similar concept underlies a system used by GE's Contractor Equipment Businesa Operations to link more than 50 sales offices across the country with GE's manufacturing plants. The system allows users to enter and valldate data, and generate local reports without accessing a Supercenter, It is also used to transmit sales propositions to a plant or headquarters through the mainframes. Although "express" or immediate transmission is required at times, the company favors the less-costly alternative of deferred transmission during off-peak hours. A program has been developed to transmit automatically at a predetermined hour when the

'RE SELLING distributive data processing. We're not selling machines.

PC uses a Racel-Vadic auto-dial modem to Initiate communications with the host. The GE-abetted proliferation of person-

Distributive Data Processing

al computers is intended to encourage existing clients to use the mainframe more often and to induce potential customers to sign on for time-sharing and software. "We're selling distributive data processing. We're not selling machines," Offe emphasized.

GE Information Services says it's discovering a growing new customer base. "Those who haven't used time-sharing before value the fact that they can tie into the mainframe." Offe continued. The marketing effort pushes the versatility of the PCs both for stand-alone functions and for communicating with the host. Korn added, "We do local data processing when it makes sense, and we do remote when it makes sense."

That philosophy is apparently paying off, Again, GE Information Services won't release figures on how much of its \$10



equipment scans the current workload and seeks out the most efficient routing of dato. During a peak load hour, the network can handle more than 6000 users simultaneously.



Operator monitoring GEIS direct and dedicated customer lines of Bockville.

million order has been spoken for by clients or how many microcomputers any particular customer has ordered. What Korn will say is this: "We have more orders than we can at times deliver." No specific numbers are being mada public, but Korn did disclose that some cliaints are buying several hundred units.

Under one of the largest agreements negotiated so far, a statewide nonprofit health insurance group is ordaring several

THE NEW GE venture has ramifications far beyond the mass purchase and distribution of thousands of micros.

bundred XTs from CR Information Sevices for an innovative physician claims system. Under the plan, participating physicians will buy XTs from CR Information Services to maintain local disbases on health insurance claims. Each day, the physicians' staffs will eater all the information normally lifted in by hand on the claims forms now ju use. Each night that the claims forms now ju use. Each night that the claims forms now ju use. Each night that data will be transferred to the main-frames on the thain insurance group can consolidate the claims.

"It will maan lowar claims-processing costs and a faste trunaround time on payment of claims." Korn said. "Also, the mainframe will automatically notify phasicians via their XTs when any information needed to procass a claim is missing. The doctor ultimetely will be able to query the current status of a claim. Where is it? When will I be paid?" Korn continued.

The physician claims system is scheduled to begin oparation sometime during the last 3 months of 1983. If successful, it will be made available in other states, opening a vast new potential market for GE Information Services and IBM. "That's the part that excites us most." Korn said, noting that GE has already reserved many market for the state of the state of the state of the last project. The declores can also use that XTS for office automation and local

data processing, Korn added.

Software Linkage and Development

The naw GE venture has ramifications far beyond the mass purchase and distribution of thousands of micros. The company is pursuing a three-prong strategy, and each prong has major implications for software devalopers and for authors in search of markets.

The first thrust is communications, Late last year, GE began marketing the first version of its softwara linkage program, Time Shoring Interface (TSI 1.0), Although developed to serve customers who want to integrate their micros with the GE mainframes, TSI 1.0 has proven a hit elsewhere. "People are seeking us out and purchasing our communications software," Korn observed, adding with a smile, "Our competitors are buying it too." The company hes not yet formulated a policy on how aggressively it wants to market to nonclients. While outside marketing would be a source of revenue, the availability of software tailored to integrated systems is regarded as a major selling point for potential Supercenter users. Korn said, "It's part of our competitiva advantaga."

A more sophisticated version of the TSI 1.0 was released this summer, Billed as a major revision, TSI 2.0 incorporatas a dialing directory, autometic log-on, a horzontal spili-screen function, the capability of creating session files, and the ability to construct incoming and outgoing masks and to remap the keyboard, among other features.

saatures. Making "productivity tools" available to clients is the second thrust of CE's strategy. The third strategic thrust is to attack vertical markets—transportation, international financa, and insurance emong them—with a complete range of software suitable for both local and remote data processing projects. It is these two elements of the company's approach that should interest software authors.

should interest software authors.
Although GE Information Services already offers more than 2,000 programs for cillants of its teleprocessing network, thesa are by no means anough, company officials stress. Even for those programs already in GE's software library, "development is required in every case" before they will be suitable for the PCs and XTs, Offe pointed out Equally important, GE is

doing little of the necessary software development in-house.

development In-house.

Much of the emphasis is on modifying existing programs and applications, and applications. The programs are applications from the programs and applications. Finance of for microcompulars. Korn observed, "People don't expect to pay as much as in the past to develop software. Despite the deep pockets of a lot of major corporations, they're not willing to undarwite development from scratch." Another reason why development from scratch is becoming arar: time. Korn cited the examples of the finance and banking industries, whose applications needs change with the regulations every 6 change with the regulations every 6

"My phone rings a couple of times a week" with authors calling GE Information Services offering proposals. Korn said. He added, "It should be ringing a hundred times aweek." So where does the company find authors? Almost anywhere, including trada shows and PC confarances. "We want the winners, the best ones thet taka advantage of our network and our services," Korn stressed.

GEIs is also hunting among the authors who've already done programming for the network's mainframes. GE is asking its present stable of authors to modify their programs for use in the integrated system and inviting them to write new programs. That corps of outhors is significant in Itself: the most recent edition of the company's directory of author programs runs to 188 pages. GE offers tools, assistance,

DESPITE THE
deep pockets of a lot of
major corporations,
they're not willing to
underwrite development
from scratch.

and guidance to help those authors keep

As an example of a mainframe software developer creating another varsion suitable for use on the personal computers, consider Evaluation and Planning Systems Consultants Inc. of Windham, New



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Hampshire, GE Information Services is already making available both mainframe and micro versions of the firm's decision support system, which is designed to serve the needs of corporate financial menagers and analysts. Evaluation end Planning Systems Consultants licensed the program to GE, which is marketing the system both in the United States and abroad. Among its applications are investment analysis, budget control and development, long-range planning, merger and acquisition activity, cash-flow forecasting, statistical studies, end what-if scenarios. It includes a data manager, e report generator, and an editor. And it possesses graphics, hierarchy and consolidation, and data management capabilities. Korn said that customers can buy rights to either version, though GE maintains that nurchesing both provides "the best of both worlds."

Another example of software available for use on both the PC and host is a worldwide procurement-tracking system developed for Bechtel Company, the internal

Accounts Pavable

tional engineering and construction concern based in San Francisco. The system contralizes shipping and logistics control and simultaneously links a multi-billion dollar airport construction site in the Saudi Arabian desert with ports in North America, Asia, and Europe.

GEIS is actively searching for new microcomputer authors, some of whom may already have designed stand-alone software and would benefit financially and professionally from a tie-in with GE. With access to GE's time-sharing network and its databases, those authors may be able to do things they couldn't do elone. Korn said. To illustrete his point, he added that an author may need to use GE's Fortran subroutine library. They may need belp in bringing their softwere up to the system's standards, debugging and using the special features of the PC, including handling the communications port and string features. The outhors also stand to gain from GE's sales force, "Let's face it." Korn said, "the big bucks are in

ccounts Receivable

Dealing with Software Authors

GE's staff helps would-be authors evaluate their proposals and negotiates compensation end marketing arrangements. The company offers a menu of financial arrengements for its outhors in addition to the professional advantage of providing eccess to technology that otherwise may not be available to them.

For example, CE information Services may offer an author a financial package with an upfront, one-time royally. Or royaltism may be based on the number adjusted may be adjusted and price of copies sold. The way a product is marketed also affects payments. In many cases, CE's worldwide sales force may exame full responsibility for marketing seasume full responsibility for marketing prefer to handle marketing themselves, especially if their software has been developed for a preclaimed interest may be supported to a fine full responsibility for marketing themselves, especially if their software has been developed for a preclaimed interest.

Campany officials acknowledge the need to treat micro authors differently from developers of mainfrense software. Once again, time is a factor. Sometimes, the shelf-time for a software program is short—perhaps 9 months to a year. "We can't spend 9 months in negotistion." Korn said. And naturally, on author's perception of a program worn't always coticide with the company's. "Sometimes the author's confidence in the package is greater than ours," Korn edded.

What is the softwere developer's best

WE WANT TO stay in certain markets, even if a particular product isn't going to make us rich.

chance of signing on with GE?

This is where the third prong of the strategy—vertical markets—comes in. Meny of what the company labels "targets of market opportunity" are vertical industries such as energy, transportation, banking, and public accounting, in eddition to vertical industries. GE also is trapeting some horizontal markets including manufacturing, finance, and order service.



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marketing."

In transportation, for example, an author may devalop software that allows large firms to keep track of the stetus of

customers make the most of integrated microcomputers. GE Information Services has started offering training on the IBM

their trucking fleets, enabling regional offices to datermine where each truck is, its condition and its availability for a shinment to a particular location that requires a specified number of days in transit. The program, using the capebilities of both the XT and the mainframa, would replace a prior setup in which communications were bandled by phone.

Even if your software package isn't worth much to GE by itself-perheps because of a limited probable market-GE could still be interested if it falls into one of the target areas. The aim is to maintain as wida a presence as possible in those fields where GE is strong end where the overall opportunities for profit are great. As Olfe explained, "Wa want to stay in certain markets, even if a particular prod-

uct isn't going to make us rich." With thousands of potential authors out there, it would seem that competition can get heavy, and it's going on in what company officials dascribe as "the battle of the markatplaca." GE is resistant to tha concept of axclusivity in seeking new programs to handle particular applications. Hare's how Korn explained the GE philosophy on the issue: "There is conflict. They competa with our own products. You do have overlap. You do have duplications. We have authors competing with euthors. we have authors competing with our products, but the principle competition is the author against the outside world." Korn added, "the merketplace will vote with their dollars on which software package is the winner."

Training

To balp customars make the most of integrated microcomputers, GE Informetion Services has started offering training on the IBM PC.

The first course, called "Introduction to IBM Personel Computer," provides menu-oriented instruction on the fundamentels of PC use end covers use of TSI as well. It is eveileble on a self-naced disk. The modular approach takes about 8 hours to complete. Alternetively, it is offered in a more formal 2-day classroom version at the customer's own site. Tha company says the advantage of the classroom approach is its greater emphasis on performing prectice exercises and the opportunity to ask questions of a live instructor.

Another micro-related course will deal with BASIC, also targeted for individuels with little or no prior computer experienca. GE said that those who complete its BASIC course will be able to write simple programs, do calculations, read from and write to files, and use the BASIC aditor. A third course is plenned on other applications for the PC. These too, will be availeble on diskette or in the classroom. eccording to the company.

The training end the prol feration of

PCs flowing from the IBM/GE arrangement can't be viewed in e vecuum. The implications reach beyond any perticular business, whether IBM, GE, or a teleprocessing customer

In mega-terms, the \$10 million egreemant meens a great increase in the number of personal computers for businesses. On a micro-level it will result in the introduction of individuels to the versetility of the PC. It will put convenient eccass to computing resourcas in the hands of more clerical, professional, and managerial workers whose prior computer exposure may heve been limited to asking specialists to do perticular tesks or to pleving video games at home. Aithough that type of exposure may not have been the principal motive behind the IBM/GE transaction, in the long run it could prove to be one of the contract's most important legecies. /PC



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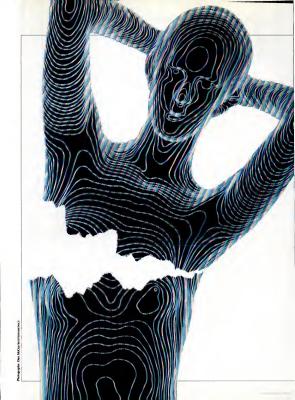
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HIDE YUD YILK ..



By using the PC to study and upgrade local emergency medical services, Ohio volunteers provide a model for the rest of the country.

(On The

"Hudson EMS, respond to Terex and Hudson Drive, eccident with injury." The dispatcher's voice coming in over the transceiver in my car was businesslike. Even in the tiny little town of Hudson, accidents are not infrequent, but fortunetely, most injuries are minor. Except at Terex and Hudson

"Bed intersection," I thought.

In the 3 years I'd been working with the Hudson Emergency Medical Service (EMS) as its medical edvisor, I'd reviewed more than just e few reports of major collisions there.

I looked over at my wife. We were on our wey to do some shopping and weren't even really beading up that way. She sighed.

"Go ahead. It's ell right." I turned the car and heeded up toward

the eccident, listening for anything else on the radio that might tell me what to expect. "Med 11's en route." I could hear its siren weiling in the distance, and decided there was no reason for us to drive any faster. The ambulence would probebly pass us soon and we'd both be there in a couple of minutes.

The radio crackled egain: "201, Med 11. Step on it!"

I recognized the police officer's voice; the sense of urgency was unmistakable. These guys didn't call for help unless they needed it. I hit the switches for the emergency lights and suddenly beams of flashing red and white light cut through the night from the front end top of the car. The next switch released the siren's wail from under the hood.

I spoke into the microphone, trying to sound celm: "Med 10, Med 11. I'm responding hot to that call. I'm in front of

you, ETA 30 seconds." The fleshing blue lights from the police cers appeared aheed end seconds leter I pulled up end sew just what I had feared: gless was scattered all over the intersection end the twisted wreckage made it all too clear that either or both vehicles had been going at a pretty good clip. The scene took on en eerie cast, as the white, red, and blue lights strobed the center of the intersection. The headlights end emergency flashers of passing cars illuminated the feces of their occupents, edding to the sense of unreality. Radio stetic end the shouts of the squad crew and police mixed with the moans and sobs of the victims.

Within seconds the crew chief had made her initial assessment and had set in motion the efficient machinery, which would see the two injured people out of their cers and on their way to the hospital in the safest, quickest way possible. Tesks were essigned, equipment was mobilized, and the emergency medical techniciens (EMTs) took their positions inside end outside the wrecked cars to begin the extrication process.

By now, you're probably wondering what all this has to do with the PC. Several years ego I would have wondered too. But todey, only 6 short months after I instelled e PC et home end brought its capabilities to beer on my work with rescue squeds. I'm wondering how I ever got elong without it. Quite simply, the Hudson EMS, end the other rescue souads I work with ell over the county, are moving to the forefront of emergency medicine in this country, end the PC is helping in that tesk.

An Unlikely Spot

The sleepy little town of Hudson, Ohio seems an unlikely spot for such lofty espirations. After ell, rescue squeds and emergency medical services are usually thought of in the context of e big city, as in TV's "Emergency" or "240-Robert." And, there's no doubt about it: L.A. we ain't.

Located in the Western Reserve (the Indianformerly owned by the state of Connecticuts as "western reserve", Rutdons's New Englend roots show through in the spirit of independence and self-reliance of the townspeople as well as in its local architecture. The people are friandly end proud, and as ensure of tradition is officielly guarded by the local historical society. The fee creams notal still draws the largest turnout of any annual social occusion and it's held on the Village Green, Ranked by

had an accident out on the highway, your fate depended on where you happened to be or whether the local funeral home ran an ambulance service.

Main Street's row of little shops on one side and Town Hall on East Mein on the other

Crime in the streets is duly recorded in the local weekly paper where the week's most serious offenses noted in the "Police Blottar" may include a bicycle stolen from in front of the drugstore. [Yes, it has e soda fountain, and yes, you can gat a chocolete phosphate.] The local constabulary is periodically dispatched to deel with a horse or cow that has broken through a force and is wandering in tha street.

How is it, then, that such exciting events in the world of EMS are emerging from this little hamlet and the others like it around the county?

Hudson provides some of its municipal sarvicas through voluntere praticipation. Both its fire department and emergency medical service are staffed by people who do whet they do because they want to help, but like the people in many small towns across the country. But when a raived in Hudson 3 years ego, the Hudson EMS had just embarked on the ambitious project of upgrading the serviciatious project of upgrading the service to what is commonly called "Advanced Life Support" (ALS), which requires the close Support" (ALS), which requires the close cooperation and approvel of a physician or medical advisor. Claim Truesdale, Hudson's full-tima administrator/paramedic, told me simply, "We want to be the best. What do we have to do?"

The answer to this question is precisely what makes this region's EMS so unusual. But I'm getting a little ehead of mysalf. Whot's happening within EMS in Hudson is pert of a much largar transformation: Something close to a revolution is occurring in this country.

You Call. We Haul!

Twenty years ago there wes nothing really resembling EMS as we know it today. If you had an eccident out on the highway, your fete depended on where you happened to be, who passed by, or whether the local funerel home ran en ambuiance sarvice. If it did, and someone did call it, whet heppened to you when the ambulence errived at the scene was anybody's guess. If you were lucky, one of the attendants might heve had a first aid course. In any case, they pretty much just scooped the victim up and tore off to tha nearest hospital in a tradition that hes come to be widely known (end scorned) as "Scoop & run" or "You call, we haul." But "Scoop & run" really hed something going for it when you consider that the elternetive was called "Lia & dia."

In 1966, the National Academy of Sciencas (NAS) published a landmark monograph entitled, Accidental Deoth & Disobility: The Neglected Diseose of Modern Society, which changed the face of EMS forever. In the monogreph, the NAS reviewed dete on traffic injuries and came to e gruesome conclusion: People involved in accidents all over the country were being maimed or killed in awesome numbers, but not necessarily because their injuries were crippling or fatal, nor because medical science was incapable of deeling with these injuries, but because no system was available that could guerantee that victims would be transported quickly and reliebly to e hospital. They were dving because, once injured, they would lie sometimes for hours, slipping into shock and then death.

Congress reacted swiftly. In the same year, the National Highway Traffic Safety Act was pessed, defining for the first time standards for emergency medical services, and conferring upon the Department of Transportation primary responsibility for

the creetion of training and certification standards for amergency medical technicians. The responsibilities of an EMS ware put down in black and white, and a netional commitment to remedy the sorry state of affeirs depicted in the NAS monoeranh became the law of the land.

In the years thet followed, training progens started ell over the country, and the folks who rode the embulances and enswered calls for help began to do so with new competence end understanding. EMS groups took on a new air of professionelism: they became contemptuous of such terms as "embulance stendant." (Fire Tip: Do not refer to an EMT as an "embulance stendant.")

Advanced Life Support

But as the medical servica revolution led to naw capabilities, new vistas, new hopes, end naw frustrations appeared. The standards for EMS had eddressed the problam of trauma on the highways, but another problam, yat unsolved and equelly deadly, began to occupy the attention of those who explored other concerns of prehosoital care: heart disease.

The first few hours of e heart attack ere the most critical. It is within the first faw hours thet heart attack deaths most frequently occur. The heart, starving for oxygen because of coronary artary biockaga,

HEY WERE
dying because, once
injured, they would lie
sometimes for hours,
slipping into shock and
then death.

becomes irritable, begins to beat irregularly, and soon mey begin just wriggling uselessly instead of pumping blood. In traum, andical professionals often telk of "the goldan hour," the period of time during which the rendering of treetment will mean the difference between life or death. In cardica crarett, the struggle abetween life and death may be limited to "golden minutes."

Four to six minutes after the heart stops numping, irreversible brain damage begins. Even if bystanders begin CPR, they can at best provide only 30 to 50 percent of normal circulation and ventilation. Each minute that goes by without restoration of a heartbeat lessens the chance that subsequent attempts to restart the heart will be effective. What's needed desperately are drugs (epinephrine, sodium bicarbonate, and others), which can prime the heart's electrical system, followed by defibrillation, the application of a strong electrical current across the chest to reorganize the beart's electrical activity into meaningful heartbeats. In fact, if these measures ara not applied within 12 to 15 minutes, the chance of survival diminishes to near

The need for these sophisticated resuscitative techniques created a problem. these methods—the administration of powerful drugs, intravenous infusions, defibilitation—were simply not available in the field. As medical techniques, they could only be practiced by physicians, which meant that they were available only in hospitals. But even the best emergency services could not hope to get cardiac arrest victims to the hospital in the

The solution was the paramedic, an

×

EMT trained beyond the basic level of rescue skills. Paramedics are capable of making a physical examination and assessing acute problems. They are trained in critical care procedures, drug administration. and cardiac resuscitation. And, under the direction of a physician, paramedics can monitor heart rbythms, start intravenous lines, administer drugs, and then transport the patient in the most stable condition offered by these treatments. The physician under whose direction the paramedic is functioning need not be present, but can provide medical direction or "medical control," as the term is often used, by two-way radio, or through predetermined written protocols and standing

The availability of paramedic skills constitutes such a radically improved level of care that squads providing paramedic-level service are referred to as Advanced Life Support units. Squads without paramedic-level service are referred to as Basic Life Support (BLS) units.

In 1973, the Federal EMS Act defined the guidelines for EMS systems at all levels, and provided for the federal funding of EMS demonstration projects to be used as models for EMS planning. While the National Highway Transportation and Safety Act assured that rescue service would become available for all who were in need, the EMS act of 1973 signified a solid commitment to move EMS definitively out of the "Scoop & run" era and into the age of professional prebospital

LITTLE surprise then, that there was an IBM PC in my future.

prectice. The result of that endesvor is dramatically illustrated by the statistical dramatically illustrated by the statistical control of the second of th

Skills Maintenance

It should not, then, be too surprising to bear that in 1979, the proud little volunteer Hudson Emergency Medical Service decided to go ALS. In the 4 years since that happened, my involvement with EMS has grown along with Hudson's advancing capabilities. As associate director for EMS at Akron City Hospital, I oversee the EMS training of resident physicians in emergency medicine, coordinate prabospital field activities with the hospital for 15 different EMS units, and personally direct the medical activities of eight different squads. When I took on the position 3 years ago, it was supposed to be a parttime job. II spend the other half of my time on duty in the emergency room seeing patients.) It has, however, rapidly and unavoidably become a full-time occupa-

Little surprise then, that there was an BM PC in my future. With endless tasks, many of which involve the management of large quantities of data, with over 100-bour weeks and 18-hour days, anything that promised to lighten the load was welcome.



The victim has been extricated and is now an the ambulance cat on a long board. The short board immobilization device is still in place. Standing over the victim is Hudsan EMS administrator and valunteer paramedic Jim Bell. The victim was moved into the med unit and transparted to Akron City Hospital, where subsequent evaluation revealed only minor injuries.

I was not really e complete stranger to computers, and small computers are not completely new in EMS. When I was an undergraduats at Yele in the 60s, I had learned to program in FORTRAN on the huge and clumsy mainframe et the computer center. Those were the days when programmers punched out lines of buginfested code on noisy keypunch machines and turned over stacks of doomed date cards to ettendants who would feed them to the cardreader and return smirking with a little printout from enother crashed run. (The amount of computer time doled out to beginning programmers like myself was pretty skimpy, so in eddition to learning FORTRAN, I became adapt at "creating" additional computer time from illicit sources.) I even had an opportunity to use one of the first IBM 360 terminal systems when it was installed at Yale, I was thrilled by how much easier it was to interact with the CRT than to go through the punch card routins at the computer center. Besides, even though the terminal didn't elways do what I wanted, et least it never smirked.

My computer deys et Yele were numbered, however. I liked programming, but medical school loomed, and with many other things to occupy my time, FOR-TRAN end debugging receded into the past as medical school and then medical practice took center stage.

But 2 years ego computers re-emerged

OES THE EMS need any help that I could provide with my computer?

in my life. Stu Averill walked into the Hudson Safety Center and offered his services to the Hudson EMS. He is e retired chemist who hed begun to occupy some of his retirement time with e recently purchased TRS-80. He knew that the Hudson EMS was ell volunteer, and even though he wasn't trained in rescue work, he wanted to help. "I heve e computer," he told EMS edministretor Cleire Truesdale. "Does the EMS need any help that I could

provide with my computer?" When Truesdale passed the offer to me, I was thrilled. We immediately set Averill to work keeping treck of various espects of the service, one of the most important of which was the skill file we kept for each paramedic. With a population of only ebout 12,000 people to serve in Hudson, we feced e very real problem; skills main-

tenance. It's estimeted thet e municipality must have a population of ebout 20,000 people before it will generate enough rescue calls to keep its paramedics proficient in various intensive care techniques. For example, a paramedic running with an urban squad may start three or four intravenous lines e dev. whereas on a rural service, a paramedic might not have an opportunity

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to stert ooe for severel weeks at a time. Regardless of how well-trained the paramedic is to begin with, this kind of inactivity inevitably results in decreesed proficiency. How can this be combatted in a town of 12.000?

We drew up a list of intensive care skills practiced by the paramedics and determined the minimum monthly number of times each skill needed to be performed. Any time a peramedic dropped below the mioimum number, additional training and/or prectice was instituted to ensure that the skill level was mejoteined. lust as a pilot must fly so meny hours each month to order to keep his license current (and legal), our paramedics hed to start so many IVs, read so many EKGs, end so on, in order to maintein standards of service. To keep treck of this, Averill set up a computerized file, which tallied all the different peremedic skills performed by each paramedic. If a paramedic started an iotravenous line on a run, thet fact would be extrected from the run report, end at the end of the mooth would be reflected to a summary that gave totals for each required skill for each peremedic.

Averill also begao tracking some data on the runs themselves end was soon able to provide us with periodic reports thet told us how old our patients were, at what times they called us most frequently, what kind of problems they had, end so forth. Averill is still our computer persoo, hut

quite a bit has changed. For starters, he isn't using a TRS any more; he has found the IBM PC more suited to his needs. But he's parleyed his computer work ioto a new husiness as one of the priocipals io the Hudsoo Computer Club. A first in this area, HCC is like a racquetball club; only instead of renting a court, the cluh members reot IBM or Apple computers by the hour. A wide array of software is available, and, of course, there is a cluh "pro" on hand to provide instruction and assistance. And resting like an archive in a corner of the club is the old TRS, a reminder of where it all started. And oow that Averill has finished the EMT trajoing, he might be doing a little hit more than just computer work for the Hudson EMS!

The addition of an IBM PC to Averill's work inspired broader, more powerful applications to my EMS work. Using currently available software, we can set up in hours data tracking programs thet used to require several weeks to get up and running. We heve recordly completed a list over 40 litems to be tracked on each one report. The list will enable us to give precise answers to nusties we have previously only woodneed about. By tracking resuccedian and their too nutties we have previously only woodneed about. By tracking resuccedian and their too nutties were able to creat the number of the call, we can tell whether the number of the call, we can tell whether the safety problem is primarily one that occurs at night, on weekeeds, or both

The same tracking system will be used to follow response times in relationships to call locations. Since, in many cases, the response time of an EMS is so critical to the outcome, we need to know when and if response times are prolooged. If a rescue squed is routicely taking 10 mioutes to arrive at calls in any giveo area, and if the frequency of calls from that area is increasing (as sometimes occurs when a oew development is huilt up), it may be time to start plenning a second station from which to base another squed. When faced with a situation like this io the past. we've been limited to surveys of portions of deta that may or may oot accurately reflect the situation. With our oew tracking system, we are able to provide e precise picture where previously only a vague impressioo existed.

The EMS Drug Book

The practice of medicine io the prehospital setting by nonphysicians is essentially different from hospital or office-based medicine. We have used the PC to help us make some helpful edeptations. For example, powerful drugs used to correct erretic heart rhythms or to maiotaio the blood pressure of e patient in shock are administered iotraveoously in carefully measured amounts. These drugs are so powerful that the dosages, often involving only tiny volumes of fluid, must be administered carefully. In the hospital, infusioo pumps are routinely used to provide exact dosage regulation; the amount to be edministered can be dieled into the pump's controls. in the field, dosage reguletioo iso't so easy.

Infusioo pumps are oot available to the field; the peremedics work anywhere a victim is found. There areo't any electrical outlets to the middle of a street or oo a lawn. The administration of a powerful drug in an intraveoous drip becomes a much more complicated task than it is in

the hospital. We used the PC to make the task easier.

Take the administration of dopamine as an example. Dopamioe is a powerful vasopressor, a drug that can help maintain or elevate blood pressure in patients in shock. The dosage edmioistered is determined within narrow limits, based on the patient's weight. A starting dose would be 5 micrograms for every kilogram of body weight infused per mioute. Tables that determine the volume to be administered per mioute or per hour are usually available. If you're using so infusion nump in the hospital, all you have to do is look up the volume to be delivered, dial in the figure oo the infusion pump, and you're all set. In the field, you must first calculate the volume to be delivered, the drip rate, and theo the correct number of drops per minute. And doo't forget to figure in the oumber of drops per cuhic ceotimeter for the administration set you're using; some drip at 10 drops per cc, others at 60.

Even under the best of circumstances where calculations may be a little hit rough. But to the circumstances of a cardiac arrest researciation, calculation may be next to impossible. The solution that came to us was simple. One year sgo, we published The EMS Drug Book. a locally distributed, pocket-sized pamphlet that coolatined actual drip rates that permedia could use to register fortunemous constitutions of the could use to register fortunemous in dropp per minute, are given in tabular from for a variety of draws in different or more a variety of draws in different or the country of
WITH OUR
new tracking system, we
are able to provide a
precise picture where
previously only a vague
impression existed.

dilutions and dosages. In an emergeocy the paramedic could refer quickly to the appropriate table and set the drip chamber reguletor accordingly.

The tables were simple to use, but com-

t is in ing up with them was far from simple. The



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EMS Drug Book provided dosage information for 14 different drugs. Calculations had to be mede to provida guidence in e variety of circumstances, including patient weight categories, differing dilutions of intravenous solutions, end different dosage strengths used to achieve different

HAT HAD once taken me 3 days now took 15 minutes. And, the calculations were error-free.

offects with the same drug. When this book was first published, it took me 3 days to do all the calculations by hand (manning with a hand-hald calculation. Tobles for each circumstance in each drug category were set up and individuel calculations were made and than entered by hand. They were checked end double-checked: small errors can produce major clinical problems.

The PC has changed all that. The first software I purchased after DOS 1.1 was VisiCalc and it wasn't long before I was eble to enter the formulas necessary to generate the drip rates. What had once takn me 3 deys now took 15 minutes. And, the calculations were error-free.

A Research Tool

I'm also using my PC to pursue e number of EMS research projects, one of which involves using simple deta analysis to datermine proper field procedures for cases of bead and neck injury. Cervical frectures and cervical cord injuries are e major cause of disability and paraiysis following head injury, especially in motor vehicle accidents. It is en unfortunete fact that improper handling of accident victims cen, and quite regularly does, convert e purely orthopedic bone injury of the cervical spine, into a neurological injury. The patient with a fractured neck bone may have no injury to the cervical spinal cord when first seen in the field, but if the head is manipulated improperly, the sharp edges of the frectured bones can slica into the soft spinal cord producing needless,

irreversible nerve damage. A person with e broken bone can be converted into a permanent quadraplegic in a metter of sec-

onds. All EMT's are trained thoroughly in the proper techniques for immobilizing the neck in cases of bead injury. With the neck properly immobilized, further injury will not occur as victims are removed from thair vehicles and transported to the hospital. Cervical immobilization techniques involve wrapping e rigid or semirigid collar around the neck while enother person holds the head still. If the victim is sitting in the car, the next step is placing a spacially designed rigid, short board behind the victim. The board's straps and buckles fasten the victim firmly and provide rigid immobilization during the subsequent extrication. Although these methods provide excellent protection against unnecessary cervical movement end injury, there is e mejor drawback: They are difficult to perform in the cramped interior of a vehicla, end they are time consuming. And time is aiweys at a premium in the manegement of e treuma victim

Why is time such on important factor? Attar all, if improper handling might result in parelysis or death, what could possibly be more important? Nothing, except that most of the carefully immobilized excident victims turn out to have no carvical injury at all. Some turn out to have other critical life-threetening injuries requiring immediate hospital treat-

A driver who strikes his head on the windshield, breaking the gless, is very likely to have also struck his chest or abdomen on the steering wheel, causing a punctured, collapsed lung or a ruptured spleen, aither of which can leed to e suddan deeth. The EMT is facad with a dilemma. If the necessary time is taken to effectively immobilize the neck of an accident victim who has sustained serious internal injuries, the deley in extrication may result in further deterioration. If, on the other hend, the EMT rushes extrication without edequete cervicel immobilization, and the victim actually does have a serious neck injury, permanant nerve damage may result, rendering the victim crippled.

Valid indicators that will tell tha EMT which petients are at particular risk for a serious neck injury have not been defined. At first, this might seem difficult to



A PERSON
with a broken bone can
be converted into a
permanent quadraplegic
in a matter of seconds.

believe. Can't the EMT identify e serious neck injury? If cervical cord injury has already occurred, end parelysis or other gross signs of disability heve set in, the injury will be apparent. But what about those victims who have not yst suffared any damage to their spinal cords? Shouldn't injury to the carvical spine be obvious? The answer is no.

obvious? The answer is no. Chay oung fellow law in the emergency room of Akron City Hospital had struck his head while driving of a Fourth of July pool party. The next day, his next began to mean proper part of the proper party. The next day, his next began to emergency room to be azamined. An X-ray revealed his neck was broken. Another young man lost control of his morbidan decided and crashed off the road one night. He picked himself up and walked home where he called the local EMS to come to this essistance. He was brought to the essistance. He was brought to the essistance. He was brought to the sestistance.

emergency room, where an X-ray indicated a broken neck. These examples serve to illustrate why cervical immobilizatioo is done whenever there is evidence of head jojury. Under our present operating protocols, any accident victim who bas any sign of beed or oeck jojury undergoes full immobilization measures. At this time, there is simply oo safe alternative. For example, whenever we find that the driver of a car joyolved in an accident has broken the windshield with his head the oeck is immediately immobilized. Even if the driver states there is no oeck paio, he may have had a concussion end be incapable of perceiving pain eccurately.

Gives the large ounber of victims who turn out to heve no cervical injury at all and the amount of time that cervical immobilization takes, we woodered if it was possible to identify those victims most likely to have cervical injuries. We set up a research protocol thet uses both date analysis and information management capabilities of the PC.

First we made a list of "prehospital

assessment data," findings that might be associated with, or indicative of, serious oeck injury, and put them into a form that could be used for date collection. This

GIVEN THE large number of victims, we wondered if it was possible to identify those victims most likely to have cervical injuries.

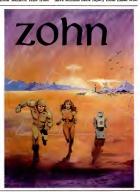
form, rapidly created using Volkswriter and the PC, locludes three different kinds of findings. The first is situationel, date associated with the mechenism of injury itself. Included io this group are types of accldeots—fells from ladders, falls from roofs, diviog accidents, motor vehicles accidents—that produce most of the serious neck injuries we see io the bospital. The next grup consists of subjective flodings, information the victim reports to the BATI, such as neck pain ("Ny neck burts.") or abournal oeurological sense. BATI such as neck pain ("Ny neck burts.") for abournal oeurological group consists of objective floding disgroup consists of objective floding displyation [POP] of the neck, or decreased sensation.

Theo we identified the Hudson EMS cure opports involving persons who underwoot cervical immobilization by the squad. Once these reports were identified, the information in the "prehospital assessment date" section was complete. Along with some basic key date, this phase of deat collection. That phase concerns the outcome. We made a list of "outcome" data that would enable us to distinguish those patients who turned out to have serious anck, lalpury from those who

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You Can TalkTo Us!

PC MAGAZINE 551 SEPTEMBER 1983

dld not.

We first used the EMS run reports to identify patients end the hospitals to which they were transported. This also enabled us to complete the "prehospital assessment data" for each report studied. At this time we are using the information from the EMS run reports to direct us to the hospital end emergency department records that will provide the "outcome" data we need.

As these deta are collected, they are entered on a Lotus 1-2-3 worksheet designed to facilitate date analysis. Since 1-2-3 also has information management capabilities, data is entered in the form of records, one per patient, with each finding listed in the eppropriate field. The DATA commands then make short work of any questions we have about existing patterns in the date, such as the age of patients with serious injury, end so forth.

Once we have collected enough data to provide a statistically significant sample. a formal statistical analysis will tell us whether we have identified any prehospital assessment findings that can be used as valid predictors of serious neck injury. It's too early to say just what we'll find, but we are hoping to produce some good hard data that will enable our EMS units to dis-

FNS HAS found a rather firm place in the area of postoperative pain.

pense with cervical immobilization unless certain key findings are identified. This will enable them to deal more rapidly with heed-injured patients, especially those involved in car excidents.

Pain Control in the Field In a totally separate research project, I used 1-2-3 to rapidly predict just how difficult it would be to collect data for a study. A physicien colleague who works with another EMS unit in our county told me he wanted to investigate the field use of e pain control device called a Transcuteneous Electronic Nerve Stimulator, or TENS. This tiny device, ebout the size of a tape cassette, sends electrical currents to electrodes, which are pleced on the body surface by means of small adhesive pads. Although the TENS is a reletively new weapon in the physician's armamentarium of analgesie, it has found a rather firm plece in the area of postoperetive pain. Placing the electrodes on both sides of a surgical Incision hes been shown to reduce the need for narcotics postoperatively. It has also been used to control other kinds of chronic pain, such as that resulting from nerve injury, which has been resistant to many forms of treetment. Could this device, my colleague wondered, be used successfully by our EMS personnel? And if so, how could we so about finding out?

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SOULT OUT THEY AND PASE OFFICIALOS.

Builty as the control of the

Offer good while quantities last CIRCLE 463 ON READER SERVICE CARD pain control in EMS is certainly vary attractive. The popular imega of the army medic quickly injecting morphine into his injured comrede is a far cry from the reality of civilian EMS. The means of dealing with pain in the prehospital setting are rather limited. In fact, strong narcotic analgesics are the last thing a critically

IT'S NO surprise to me that my colleague chose the IBM

injured-patient should receive. Shock from blood toss lowers blood pressure, and morphine, which also causes tha and morphine, which also causes that should result to a person whose blood pressure is already changerously low. Furthamore, the administration of morphine can produce drowslares or aven unconsciouses, hopelessly blurring the signs the physician must use to assess the pressure, degree, and progression of head riputy. A critical sign used to assess the action to further described to the state of the control of the c

But most of the injuries seen by squade parsonnel are not this savee. But squade parsonnel are not this savee. But squade parsonnel are not some stars are considered as a square part of the parson o

I advised my colleague to invastigate this question in the formet of a formel research project. He suggested the use of TENS in an unorthodox setting. The projected EMS application for TENS was odifferent from its current uses that the risk factor had to be considered. Might list application, for example, interfere with proper immobilization, or unnecessarily delay transport to the hospital?

The research format was agreed upon, and my colleague set out to design the project. One of the problems he encountered was the low availability of subjects. How long, I asked him, will it take your squed to see enough victims for whom TENS might have a potential use? Obtaining a valid sample would be time consuming. To help him through this part of the planning. I called upon 1-2-3 and a series of 100 consecutive rescue calls from one of my squads. The research protocol called for the use of TENS only in cases of nonlifathreatening trauma. Each of the 100 run reports was examined to see whether or not TENS would have been offered. Of the 100 runs. I found that 10 met the criteria. The rest was easy. A simple table was sat up using 1-2-3's Date functions. The dates of the first and last of the 100 runs were entered, and the differanca calculated. This gave us the number of days required to generate 10 runs that could be used in a TENS study.

How many days would it lake to collect. On cases? We step a WHAT-IF table and got a vary quick answer. 480 days. But this was for on of my squads. How about the my colleague's squad, where most of the my colleague's squad, where most of the research would be done? The squad I had used to analyze those 100 consecutive proprist, that Tallandage Fire Department, served a population of over 15,000 people and was considerably busier than the Copley Fire Department, which served a population of under 1,000.0 Would we have to do the whole study over? The enswer, for tunately, was no.

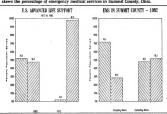
Although Coplay is smaller, the kinds of problems seen by its EMS are almost identical to those sean in Tellmadge. We set up another table, using the annual run totals for each squad. Since we know bow amay TENS runs would be collected from 100 squad runs how long it took Tail, and give openests 100 consecutive runs, it was a simple matter to set up the table top-ley to generate e semple of 100 TENS runs.

The study was approved by the hospital research committee and is now in progress. That was 3 months ago. And guess who bought himself a personal computer last week? It's no surprise to ma that my colleagua chose the IBM PC.

The Newest Specialty The rapid growth and advancement of

EMS capabilities in this country has of emessity been parallaled by the growth of emergency medicina as e specialty. At ons time, just as an accidant victim's fate often depended on who, if anyone, came to the rescue, the subsequent treatment in the hospital depended on who, if anyone, was in the emergency rooh. In many hospitals, physiciens on the staff, regardless of specialty, training, or experience, would take turns rotatine coverage for the emergency

Figure 1: Two examples of simple but relevant tables generated as part of the emergency medical services study conducted by the outhor. The table on the left contrasts the nationaride availability of basic life services and advanced life services in 1972 to their availability in 1982. The table on the right shows how inclusion of the City of Akron skews the percentage of emergency medical services in Summit County, Ohio.



room. This meant that in hospitals that did not sea many emergency patients, tha patients would see a nurse in the amargency room, who would phone the doctor at home to determine the treatment, and whether or not the doctor would ectually come to the hospital. Even in busier locations, where doctors were always present, quality of care often suffered from a mismatch of patient problems and physician skills; a surgeon would treat a severe asthme etteck, or an internist would be confronted with a badly injured eccidant victim. The growth of emergency medicina, the country's newest recognized specielty, is changing that forever,

In 1979, 10 years after the formation of tha Amarican College of Emergency Physicians (ACEP), the specialty of emargancy medicine wes formelly recognized by the American Board of Medical Specialities and the first series of board certification exams in amergancy medicine were leunched. More and more emergency rooms around the country have been transformed into emergency departments staffad by amergancy physicians, specialists trained to provide optimal care for the vast arrey of problems presented by the sick and injured who pass through the hospital's doors. The relationship between emargency medicina, emergency physicians, and EMS has been similarly trensformed

Emergency physiciens have come to enjoy a special relationship with EMS personnel, providing the interface between field and hospital. It was only natural that ACEP should commit itself to the training and direction of EMS personnel. In addition, an amergency physician's training end prectice must include some interaction with EMS. For example, at Akron City Hospital, where our Emergency Medicine Residency Training Program anjoys a reputetion as one of the bast in the country, participation by our resident physiciens in EMS training and supervision is man-

datory. This commitment has made Akron City Hospital EMS (ACH EMS) e buzzing center of EMS ectivity in our county. Saveral years ago, a computer might not have been necessary. Now, it's hard to imagine running the operation without it. No fewer than 15 different EMS units in this region look to us for medicel direction and training. Acquiring the PC has enabled us to

ARTICIPATION bu our resident physicians in EMS training and supervision is mandatoru.

fully grasp the extent of our work, and to define ourselves as part of a larger nationwide emergency medical servica nat-

work The vary first week I put my PC into operation. I was busily plugging population figures into a VisiColc worksheet, learning the commands as I went along. Population figures and EMS capability for each municipality in Summit County ware antarad. Wa knew that just over half of all the people in the United States hed access to Advenced Life Support EMS. end that this figure was probably skewed by the fact that 92 percent of people living in cities with populations over 150,000 were served by ALS. But whet we didn't know was where wa stood. ALS cennot happen without physician participation. guidance, and direction. Our work in this

to know if we were making progress. The worksheet told us.

Almost 72 percant of the county's population of over 500,000 hed eccess to ALS, considerably above the netional everege. And although these figures, es pradictad, were skewed by the ALS service in Akron, which serves almost half the county's nonulation, using a few quick WHAT-IFs on the worksheet told us that we were still close to the national everage, even without Akron's figures.

Since that analysis was made in early 1983, two changes have occurred. I'va moved these calculations to a 1-2-3 worksheet, which enebles me to analyza ALS versus BLS capabilities more easily through the DATA, SORT and DATA, OUERY commands, instead of first saparating figures into saparate columns for ALS end BLS, es I had to do with VisiColc; 1-2-3 also provided me with the graphic representations of thase percentages (see Figure 1)

The other change in the worksheet occurred in the southern end of Summit County, in Green Township.

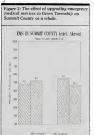
Changing A to B

About 2 years ago, firemadic (firefighter/paremedic) Devid Calderone of the Green Township Fire Department visited me in my office and spoke e few words that sounded awfully familiar: "We want," he said "to upgrede to Advenced Life Support. And we want to be the hest "

It was e long haul, involving countlass hours of training and planning, but on May 15, 1983, Caldarona's dream cama true. The ALS EMS of the Green Township Fire Department went into service with 12 full-time firemedics. When that heppened, I changed the BLS next to "Green" to ALS on my 1-2-3 worksheet and watched the other numbers change (see Figure 2). Wa had surpassed tha national average of 52 percent ALS, even axcluding Akron's population from our figures. Not bad!

By the time you read this, the picture may have been eltered agein. Paramedics with the tiny Vallay Fire District ara busy planning for the time when they can implement ALS, and the city of Norton is

on the brink of doing the same. When that happens, I'll simply change e "B" to en "A"-and wetch all the num-/PC bers change.



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BOOK REVIEW/DAN ROBINSON

The reigning master of PC technical arcana shares useful secrets and suggestions about languages, routines, and hidden programs.

Peter Norton Tells All!

your own programs.

Inside the IBM PC: Access to Advanced Features and Programmine

Robert J. Brady Co. Bowie, MD 20715 320 pages; \$19.95

CIRCLE 800 ON READER SERVICE CARD

Peter Norton has lifted the shroud that hides the secrets of the IBM PC with his new book, Inside the IBM PC. It reveals the laner workings of the computer as shows programmers how to take advantage of the many features of the PC. Much of this book applies not only to the PC, but also to PC clones and to other computers that function under MS-DOS.

Peter Norton is the fellow who stares at you from the ads for his Norton Utilities with an arms-folded, Superman stance. His pioneer Utilities provide the ability to modify data on disks, recover erased files, and conjure up miscellaneous magic with the computer. Norton hes also suthored articles on the workings of the IBM PC and

approaches to programming it in Pascal.
Although Norton is se gentle as he can
be with beginners, his subtitle signals that
the book is for more experienced users:
Access to Advonced Fectures and Programming. This is what his book is all
about. With Norton's helping hand, you
can learn the location of the PC's internal
notines and how to make use of them for

Norton expleins how hardware is designed around the Itel 8088 central processor. He tells how its registers work end how it relates to the rest of the computer and the outside world through its ports. Norton shows how the read-only memory (ROM) of the PC is allocated to such purposes as BASIC and the basic input-ofunction.

system (BIOS). He maps the rendom access memory (RAM) for functions such as the monochrome- and color-monitor displays, and he speculates on the future of the PC based on the location of unused memory.

PC Routines

As you read about the inner workings of the PC, Norton invites you to tag elong by using the program listings he provides. His Assembler, Pascal, and BASIC source-local listings give you access to many of the PC's routines. These help you crack the code of the PC as you read the book. They also serve as the bare bones of your own program routines.

Norton discusses the hidden IBM-BIO.COM and IBMDOS.COM programs that reside on the system disk as well as the larger COMMAND.COM program. He gives a clear explanation of the format of

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the directory, file aflocation table, and boot sector.

He briafly describes the primary file types such as text and data, COMand EXE. Using Debug, he shows how a program is put together by taking it apart, and how to snoop through the ROM with it. Inside the IBM PC is a treasure map to

all of the golden routinas buried within the PC, for the real gems of the book are in the access of built-in routines. These are in the ROM and are called by the PC's interrupts. Norton shows you how to do this.

A partial list will what the appetite of any programmer: You can use the DOS service routines to capture the Control. Break combination, and read or write disk sectors. Other routines get characters from the kayboard or RS-232; echo to the scene: send bytes to the printer or RS-232; set the default drive, open, closs, ersae, read, or write a file; perse a file name for a file control block; read or sat the date and time.

With the ROM BIOS services you can reset the drive, format s track, find a diskeror code, read or write anint rateck; set foreground and backgound colors; salect the 40 or 80-column mode in text or gaphiac with or without color, or choose the monoclavome display. The cursor size may be set or moved, and its location read. You can read the light pen position, which has extree paged visites, article assistant has extree paged visites, article its attribute to the acreen, or read what's there.

It's true that much of this information may be exhumad from the Technicol Reference Monuel by those who speak IBMese, but Pater Norton has made a clear translation and has added a great deal that IBM never told us.

Key Tricks Have you ever wished there were 40

function keys on the PC instead of only 10? Norton shows bow your programs can use combinations of the function keys with Alt, Ctl or Shift to provide 40 special functions.

It's through the keyboard that the comdespitae
putar communicates with its operator, book he
and Norton gives us a new bag of tricks to
program
help. He shows bow the special insert. IBM PC
Caps Lock, Num Lock, Sroll Lock, Shift,
gramma Alt, and Cll keys can be intercepted. He Petar Ne
roulains the Cl/Ali/Dial and Cll Rick key
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routines, togathar with a means to tell if kays are repeating or if they bave been released.

Norton axplains how to generate up to

NORTON HAS put the full power of the IBM PC within reach.

128 custom graphics characters, which can be displayed in your program as assily as lettars of the alphabet. This is one way that the PC could be adapted for use with Greek, Russian, or Japanese or made to perform special graphics functions quickly and easily.

Norton gives us the key to activate the Print Screen function from BASIC and it shows how to take advantage of the PC's built-in speaker and take control of the IBM clock.

An Indispensable Manual

Norton explains how to set resident routines that won't be stapped on by other programs loaded from DOS and how these can be integrated with the naw program. He shows how to write a copy-protacted disk to foil computer pirates, and summarizes the codes to get the most out of the IBM/Epson printer.

At the end of Inside the IBM PC, Peter Norton gives his readers a gentle shove to get them started in IBM's assembler languaga. He shows us how it can be integratad into Pascal and BASIC programs to provide accass to all of the PC's power.

An option offered with Inside the IBM Cis a disk of sample programs written as a companion to the book and containing all of the programs listed in it. In addition, the disk includes one of the stars of the Norton Utilities series, DiskLook, which permits you to see the data in any disk or file sector. Norton has written Inside the IBM PC

in a clear style that is simple to follow despits its technical nature. With this book he has openad a whole new world of programming and put the full power of the IBM PC within reach. Every serious programmar of the PC is sure to find space for Peter Norton's book right next to the DOS manual.

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BOOK REVIEW/JOHN FOWLER

It bears repeating: "Never judge a book by its cover." Problem is, with the glut of computer books on the market, just how else can you choose?



Beouty . . . ond the beast, os judged by the covers alone.

Two Basic Alternatives for Learning IBM BASIC

Programming the IBM Personal Computer: BASIC

Neill Graham (CBS College Publishing, New York,

291 pages; \$17.50 CIRCLE 794 ON READER SERVICE CARD

User's Hondbook to IBM BASIC Jeffrey R. Weber (Weber Systems, Inc., Cleveland, OH,

309 pages; \$13.95

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CIRCLE 795 ON READER SERVICE CARD

You're standing in the computer books section of your local bookstore trying to find something to help you learn how to program that newly purchased IBM PC. This section of the store is much bigger than it was a few months ago; there are lots of books here. From the wide assortment, you pull out the two listed above. Which

one do vou choose? The problem of choosing computer books is a difficult one these days. The market is such that a book's useful lifetima lies somewhere between a few months and a few years. Consequently, the production of a book is often hurried, and instance, the last half of a book might be crammed with tables, pictures, or anything else that appears to be useful and for which reprint permission can be obtained easily. Neither of these books is guilty of such blatant padding, although one of them does duplicate information you will already have access to if you own a PC.

On the other side of the equation, the buyer usually has precious little to go on when selecting a programming book. Presumably the prospective purchaser doesn't know enough to judge the book's merit. And even with knowledge, it's hard to make a decision in just a few minutes in a crowded bookstore. Sometimes an intelligant salesperson can help, but sometimes help simply is not available. I suspect that, in fact, the cover often sells a book.

To tast my theory, whan I got these books home I laid them on the table and waited to see how the other members of the household would exect to them. Without exception, they went for User's Hondbook first. Maybe a book shouldn't be judged by its cover, but planty of tham are. This book is shorter but thicker than the other one. It fits well in the hand. The covar sports an apparently digitized picture of Einstain. It looks official and reeks of commuteresse. And if none of this impresses.

you, those sad beagle eyes just beg you to "buy me."

Programming the IBM Personol Computer: BASIC in contrast, exhibits just about the plainest cover you're aver likely to see: a simple color design on a mostly black background. If you take the time to appreciate it, it looks nice enough but lant going to attract the eye of browsras, which is a pity, as Neill Grahm's Programming the IBM really is the better book.

Programming the IBM

This book starts out gently. The introduction urges you to axperiment with your computar, reassures you that you can't do permanant damage by typing at the keyboard.

Nothing is assumed about the user's experience with computers. Chapter 1 bagins with a description of how to turn on the computar and start BASIC. The author recommands at the outset that readers keep thair PC manuals bandy. Book space is not wasted by reproducing illustrations and tablas that can be found in the manuals.

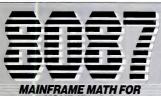
Throughout the book, BASIC concapts and statements are illustrated with programs, most of them short enough to be entared and triad as you read. Almost avery page has at least one sbort program. They are well written and easy to read. Most are in full-sized green print. The first program the reader comes to

begins

10 PRINT "Greatings from your computer."

If this is too easy for you, be petiant. The programs do more than just illustrate concepts; some appear to be useful and/or antertaining in their own right.

saltertaining it their own right saltertaining it their own right saltertain pages on sorting methods, including an example of Shall sorting an efficient salter and
The book also covers the usual things you would expect in a volume on BASIC



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programming-chapters on data types, variables, loops, functions and subroutines, formatting, strings, event trapping. and graphics.

The organization is a bit unorthodox but nonetheless effective. For instance, the chapter titled "Repetition" explains not only FOR-NEXT and WHILE-WEND,

by clarity and completeness. The author obviously understands his subject and prasents it in a clear, reassuring style. book to IBM BASIC is that it uses a great

User's Handbook Part of the problem with User's Hond-

deal of space to give information that

you'll either already have if you own a PC or won't need to know. For instance, the book begins with a hardware and system description. There are pictures of the computer (you know what it looks like), disks (you know what they look like), the system board, and so forth. There are tables (CPU characteristics, BIOS interrupt vec-

write your programs for others, detection and trapping of input errors is a very desirable

but also READ and DATA, which also usually involve repetition. And the chapter on event trapping contains a section on the PLAY statement, located there becausa MB (music background) is a type of avent trapping. There are, however, no programs for light pens or joysticks, which also use event trapping.

feature.

An important chapter to include in any introductory programming book is one on designing and dabugging your program. This book includes such a chapter, with good advice about modularity of construction, avoiding unconditional jumps, and testing and debugging. Top-down design using structured routines is advocated as an approach to minimize bugs and promota understanding. Anyone who has had to dig out a year-old program to debug or modify should appreciate this. Bug finding with TRON is covared, and the author points out that if you write your programs for others, detection and trapping of input errors is a very desirable feature. "?Redo from start" must be the most frustrating prompt avar davised.

Most of the chapters end with a set of exercises, but many readers won't bother with tham unless they are using the book as part of a course. The exercises, howevar, appear to be well designed and will reinforca the reader's understanding of the concapts and techniques presented in the chapter.

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tor functions, RAM and ROM characteristics), and a brief description of the operating systems. None of this is of much help to the neophyte BASIC user. The most useful introductory information is duplicated from the menuals that came with your PC.

Useful information about BASIC pro-

gramming starts in Chepter 2. Topics are covered rather hastily, es only 93 pages heve been allotted. If you elreedy know BASIC, these 93 pages might suffice es an introduction to the IBM version. Most of the topics that the previous book covers are elso found here. The difference is that the information is compressed and not nearly as well-illustrated. Only a few sbort progrems are included, and none are particularly useful. Examples and problems et the ends of the chapters ere elso miss-

Chapter 2, "Introduction to IBM BA-SIC," hats the different versions of IBM BASIC, explains how to enter eprogram from the keyboard, and discusses variable anneas and types. The next chapter, "Beginning IBM BASIC," gets into BASIC statement structure, mixing variable types, precedence of operations, relational operators, input and output, confideel stetements, and branching. But everything some by too unickly.

taning goes by too quickly. "More BASIC Concepts." Chapter 4. includes tables and arrays, subroutines, edwenced printing concepts, RND, strings, functions, graphics, end logical operators. The advanced printing section omits the ! and 'n spaces' string fields. Like most others, this section is better bendled in Programming the IBM.

However, the User's Hondbook coverage of logical operators is superior to the equivalent section in Programming the IBM. There are several tables that show the effects of the logical operations available on the PC, bit by bit.

Chepter 5, which purports to be about files and file handling, spends more than half of its space covering DOS diskette operations, such as how to copy your DOS diskette and verify it with DISKCOMP. There's even e full-page picture of a 5%-inch diskette, as if the half-pege picture on page 33 were not enough.

Chapter 6. "Advanced Concepts." hes seven pages of explanation about the program editing keys, but haif of the chapter consists of tebles containing informetion available in the BASIC menuel. Finally, there is a single page about TRON end TROFF, but that's it.

A reference guide with appendixes cocupies the second held of the book. The guide describes the BASIC statement set for be CV. Sendy veryfixing in these sections of the control of the co



an alternate set of BASiC statement documentation for the PC. But, if you want to learn about BASIC from the beginning, and about good programming practice. you will be better off with Programming the IBM.

NYBOOK in such a rapidly moving field stands a chance of being out of date the day it is published.

Omissions and Errors

The PC is much less of a static system than, say, the Apple or TRS-80. Improvements come along every year or so, the cause of serious heartburn to writers and publishers. Any book in such a rapidly moving field stands a chance of being out of date the day it is published. Both of these books suffer, at least slightly, from this problem.

You won't find anything about BASICA 2.0 in either one. Both were written when DOS 1.0 was the standard. Programming the fBM does contain some notes, apparently added in the final stages for DOS 1 10

There is not much about graphics in either book. If your interest lies in this area and you already know how to program in BASIC, neither book would be a good choice, especially since most of the Version 2 (Lenbancements to RASiC deal with

graphics. Probably every programming book ever written has at least one bug or printer's error. I found a few in User's Hondbook. On page 111, the CSNG function is printed as CSGN. This is particularly unfortunate, since the SGN function is discussed just above it. My son, who went right to the good stuff, found that the example for PLAY, on page 248, doesn't work; there are two fatal mistakes in this three-line program. You won't find either one of them unless you know something about music. But I'll leave you with a hint: Did you ever try to play an L#? /PC

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optional.Color monitor recommended.

Evolution is a higher game form. This is a very clever, well designed game that may mark another step in the evolutionary chain from Pong, past Spoce fnvoders, and into worlds vet unimasined.

into worms yet unimaginea.

Okay, it should be obvious that I like this game. I don't want to get too carried away, though: it is still a silly little divertissement, but there is such obvious attention to detail and imagination in this product that it earns a high ranking on the Dar-

winian chain.

There are six different challenges in this game, with three levels of difficulty. It is can be played from the keyboard or with a Joystick. I recommend the joystick. I recommend the joystick. I recommend the joystick. The game requires a color/graphics monitor and displays gorgeous, finely crafted images on an RGB monitor. The sound effects are well done, and each of the six screens includes its own his of themse screens includes its own his of themse



Monster to the left, monsters to the right, on asteroid above, ond the dorkness of space beyond in Space Miner.



Lining up for o drive down the dog leg back nine on Golf Challenge.

So, on to the game of Evolution: You start out life as an Amobeb. Maneuvering around in a liquid medium, you try to est DNA cells. Unfortunately, life as an Amoeba is not limited to mere grazing you are pursued by spores, microbes, and the attackers do not foliow predictable paths. You must estudy sour attackers, but as an Amoeba, you have a limited number of shields to provide temporary safety. But with luck (and practice) you set all of the MDA, and it's time to move up to the next

As a Tadpole, you are a cute little fellow running back and forth at the bottom of the screen. You can go laft or right, or you can jump. Your aim is to snare one of the elusive fluttering water flies without being caught in the laws of hungry fish.

If you set your quote of three flies, you become a Rodent. Here you burrow around in an unmarked cave, making your own maze. Your aim is to eat wedges of cheese that appear in the tunnel behind you; your challenge is to avoid speedy

snakes racing around looking for you. You can kill a snake by dropping a pila of dung, but you hava only three passes at that dafense. When you manage to eat five

EVOLUTION earns a high ranking on the Darwinian chain.

cheeses, its on up the ladder.

Now you are a Beaver. On the right side of the screen is a stack of sticks. You're on the laft and between you and the sticks is a river full of alligators. Your assignment is to swim across (without getting yourself caught by the alligators' gaping mouths), retriave the sticks, and build your dam.

Harder done than said.

The next step is that of a rare orange Gorilla. You must protect three oranges from thieving monkeys by throwing coco-

nuts at them and dislodging them from the trees. This stage is surprisingly easy, but it serves as a breather before the "highest form of evolution."

Here, alas, Evolution, takes a turn toward the mundane, (Or maybe it is merely that humankind is so predictably, hostile) Anyhow, the Human level of Evolution is a shoot-sm-up in space: You against the genetic mutants it is a welldasignad segment nevartheless, with that additional filling of having to avoid the richochets of your own shots as you maneauver around the screen.

maneuver around the screen. The copy-protected game presented no problems in operation, although I was disapointed to find that I could not escape to the operating system by command or even by using the Chri-Alt-Del Combination. The only way out of Evolution is by shatting of the power. When the game, we have the company of the compan



Arcadian evolution: In the game, Evolution, life begins as an Amoeba and advances to Tadpole, Rodent, Beaver, Gorilla, and Human. This history of life is fraught with peril.

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CIRCLE 435 ON READER SERVICE CARD

diel practice.

i don't know if this is exactly what Charles Darwin had in mind, but this game might heve made Clerence Darrow's case a lot stronger in the Scopes Trial.

On PC's scale of one to six, Evolution ranks as follows:
FUN: 5
CHALLENGE: 5

 CHALLENGE:
 5

 GRAPHICS/SOUND:
 5

 TOTAL SCORE:
 15

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sticks and game adapter optional.

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Stuck in spece again, pursuad by gob-

bling monsters and chasing after elusive asteroids, energy clouds, and other objects? Welcome to Space Miner, another version of the shoot-em-up in space.

There are, bowavar a few surprises in

RANKLY, I'd rather watch the grass grow.

this game, including an opening thame of the Goldberg Voriotions by 1S. Raviotions by 1S. Raviotion should be suffered to the state of the st

The game can be run from the keyboard with a bit of ewkwardness. With a game adapter in place, joystick can be used. Space Miner does not recognize the existence of both a color and monochrome adapter, and the owner of such a system must make the switch with his own commend. There is a pause control and a

"panic" escape key to dump back to DOS in case the boss rounds the corner unexpectedly.

3

4.5

10.5

Space Miner scores as follows: FUN: CHALLENGE: GRAPHICS/SOUND: TOTAL: Golf Chollenge Sierra On-Line, Inc.

Sierra On-Line, Inc. 36575 Mudge Ranch Rd. Coarsegold, CA 93614 (209) 683-6858 List Price: \$24.95

Requires: 64K, color/graphics adapter, color monitor. Joysticks and game

adapter optional.

CIRCLE 790 ON READER SERVICE CARD

If you like golf, you'll probably fied this game about as exciting as being trapped behind a foursome of Cub Scouts who refuse to let you play through. If you don't play golf, you'll probably fied this game eyes less thrilling.

According to the lostructions for Golf Chollenge. "You size up the shot, you address the ball, your putter swings forward, and . . . if the angle is correct you will sink the putt: if it is oot, it is just another bogey. You can control every shot on the course just as you would if you were playing in the Masters."

If that's true, you can call me Arnold Palmer. I found Golf Chollerge to be warkward, slow adaptation of the bome video game cartridge products in which you move a little stick figure of a man around a set of 18 almost indistinguishable "boles" and swing a barely controllable club in the general direction you'd like the ball to go.

The copy-protected disk includes an option for joystick or keyboard cootrol of the mao and his club. You can select as maoy as four players, an RGB or composite monitor, turn the sound on or off, and choose to play all 18 holes or the first or last 9.

Frankly, I'd rather watch the grass grow. /PC

| Golf Chollenge rates: | FUN: 2 | CHALLENGE: 2 | GRAPHICS/SOUND: 2 | GRAPHICS/SOUND: 6 | GRAPHICS/SOUND:

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CIRCLE 449 ON READER SERVICE CARD

Questions about correct use of filenames in PC-DOS, controlling printers from WordStar, and how to tell the difference between the 8088 and other Intel chips are answered in this session with the PC Tutor.

PC Tutor



The 8088's Family O: Could you please explain the difference

Q: Could you please explain the dimerence between the 868 chip used in the IBM PC and the other microprocessor chips available from Intel that are labeled as compatible? Can I plug these newer chips into the PC in place of my 8088 and will this give any speed advantage?

A: Intel presently sells five different microcamputer chips that will run IBM PC programs. They are all different and cantain properties that give them advantages. But the only chip that will plug into the PC's sacket is the 8088, which is the ane already there.

You are probably familiar with two chips: the 8086 and 8088. The two are completely software compatible. The anly difference between them is that the 8086 speaks to the autside warld over a 16-bit data bus, while the 8088 uses an 8-bit data bus.

When a microprocessor has to read an instruction or write data to memory (as when executing a POKE), it communicates over a data bus. By having a 16-bit instead of an 8-bit data bus, the microprocessor can tronsfer data and read instructions twice as fast. This does not mean that the 8086 runs twice as fast thas the 8086 runs twice as fast to the 8086 runs twice as fast to the 8086. Ruther, the total people advan-

tage will be more like 30 to 60 percent.

depending on the instructions used.

For example, when BASIC performs a

POKE instruction, this trousters only 8 Birth Foreign and the process of the processor, either processor will run of the some speed.

A register is a piece of very fast memary internal to the microprocessor chip. Mochine language instructions almost always manipulate registers. Let's laak at an example in assembler cade:

ADD AX.AX

This instruction tells the processor to take the contents of the register called AX and add it to itself. (This is like the following BASIC instruction: X = X+X.) After the instruction is performed, the new value in AX will be twice the old value.

The 8088 processes this instruction in

two steps. First, the instruction is tetched in from memory. In memory, the irrepresentation octually looks like 2 bytes: 1, 192. Thus, an 8088 will look be twice as long an 8086 see that one of the instruction. Once the instruction is fetched, the prolocate the instruction is fetched, the prolocate the instruction is fetched to double the AX register. Execution proceeds at the same speed whether the children is the same speed whether the children is no 8086 are no 8086.

Actually, Intel designed the IAPX series (8008 et al.) of chips very clearly. The fetching mechanism is distinct from the execution mechanism. While the execution mechanism. While the execution accounting "ADD AX.AX" it simultaneously fetches another instruction. Thus, you can olmost figure instruction. Thus, you can olmost figure instruction that the contract of
Thus, the 8086 will run twice as fast as an 8088 when ane of two things happens: when it reads ar writes 2 bytes of informatian, ar when it executes an instruction that was not previously fetched.

A lat goes an inside the 8088 chip in arder to execute that "ADD AX.AX" instruction. In the some way that BASIC interprets "X = X + X," the 8088 has to interpret "1, 192." The "ADD AX.AX" instruction is the simplest instruction in the 8088 repertoire. This instruction can

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cutes in obout 600 nsec: Another woy to soy this is that an 8088 can double the AX register 1.6 million times per second.

A mare camplex instruction is "ADD AX,[12]." This instruction requires 3,000 nsec. In the 8088 and 8086, the instruction is decoded as follows: First the instruction is fetched; then 12 is added to 16 times the volue of the DS segment register; finolly the contents of that effective address are odded to the current volue of the AX register. The process would be like this BASIC instruction:

X = X + PEEK (12 + 16*DS). Since the IBM BASIC daes nat support addressing through the full range of the PC, this would really laak like: DEF SEG = Ds : X = X + PEEK (12).

In the 8088 and 8086, the instruction is interpreted and the oddition is performed just as shown here. In the newer chips from Intel, most of this work takes place in the chip's internol hordwore, rather than in its internal softwore, knawn os microcade.

The newer chips from Intel ore colled the 80186, 80188, and 80286. Nat only da these chips execute these complex instructions much faster, but they hove odditional features

The 80186 and 80188 (Intel's 100 series) ore 16-bit and 8-bit causins to the 8086 ond 8088. Every 8088 ond 8086 mochine longuoge instruction will olso run an the 100 series chips, anly much faster. Unlike the difficult process of maying programs from o Z-80 to on 8088, you con toke o program that runs an an 8088 and mave it without modifications to an 80188. The 80188 and 80186 also contain odditional circuitry that replaces other partions of a microcomputer, including DMA circuitry, interrupt hondling, ond counters. The circuitry olso adds a few new instructions. The net result is that you can create a personal computer using the 80188 that runs substantially foster thon the 8088, and at a lawer system cost

The 80286 runs the same instructions os an 8088 ond executes instructions at the same rote of speed os the 100 series chips, but it does not contoin the odditianal camputer circuitry. Instead, the 80286 hos the capability of supporting virtual memory. To give you o feeling for how virtual memory works, consider this BASIC instruction:

DEF SEG = 20000.

On the 80286 a segment is not a real lacation in memory, but a pointer to 64K bytes samewhere. If the segment lobeled 20000 is in memory, then DS will be loaded with the oppropriate value and executian will cantinue. If the segment lobeled 20000 is



not in memary, then a routine con be called to read the appropriate 64K bytes from o disk, while writing out Ithot is, swapping with) a piece of memory that is not being used ot the moment.

Virtuol memary is an exciting feature. If you have only 128K af memary in your machine, yau can still run o program that expects you to hove 1000K. The program will not even know the difference, olthough you would notice more disk activity (for swapping segments in ond out of the disk) thon would someone who had the full complement of memory availoble.

In summary, the newer Intel chips serve twa purpases. The 80186 and 80188 ore designed to let manufacturers produce high performance, but inexpensive, personol computers. The 80286 is designed far high-performance virtual memary. usually an multi-user mochines. All three chips run o superset of the 8088 instructions.

There are two good references for more information on these chips. The April 1983 issue of Byte hos on excellent article describing the copobilities of the 80286 f"Virtual Memory for Microcomputers" by Stephen Schmitt) and on orticle describing the 80186 ("Intel's 80186" by Tany Zingale of Intel), Trocy Kidder, in his book Soul of a New Machine describes the internals of microprocessor chips in a readable manner.

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CIRCLE 105 ON READER SERVICE CARD

attempted to copy WordStor over to RAM-

COPY WS * . * C:

I received the error message "file can not

be copied to itself." What is going

Patrick M. MacLeod

disk, via typing:

wrong?

Kingston, Ontario, Canada A: I om ofraid that your problem is unreloted to the RAM-disk. Instead, the difficulty lies in a fine point in the printed instructions. (This sort of problem often hoppens when one ottempts to copy o program fram o mogozine.)

The problem is that you left a space between WS and the first osterisk. The correct syntox should be:

COPY WS* . * C:

When you leave the space between the WS ond the osterisk, PC-DOS tokes your commond to mean "COPY oll of my files nomed WS to whotever their nomes ore." Of course, this is illegal. It would be nice it PC-DOS onnounced that it had ignored

the "C:," but it never reached that spot. When you copy files using COPY, you ore given the option of using ombiguous or unombiguous nomes (the documentotion tends to coll these "ofn" ond "ufn"). The simplest woy to describe these two types is to first discuss noming conventions.

Every file in PC-DOS is described by o

HE ASTERISK (*) character matches any bunch of characters while the question mark (?) matches any single

character.

prefix and o suffix. The prefix moy be up to 8 characters in length and the suffix moy be up to 3 choracters in length. Volid nomes ore WS.COM and CHKDSK.COM. The name CHECKDISK COM is involid becouse the prefix is 9 choracters. These ore unombiguous file nomes, becouse the nome refers to exactly one file.

bunch of files of once, PC-DOS uses soeciol wildcord characters (* and ?) to assist in that. Thus, when you call o file WS*.COM, the name actually refers to any file whose prefix begins with the letters WS and whose suffix is COM. Similarly, WS*.* includes two wildcords: this nome refers to ony file whose prefix begins with

WS and whose suffix can be onything. A simple way to understand naming conventions is by experimenting with the DIR commond. Ploce your PC-DOS diskette in drive A, type A:, press Return, ond try entering the following:

DIR B*.* DIR BASIC. * DIR BASI?. * DIR *B. *

DIR B????? . * DIRB

After o few tries, you should be oble to notice the following pattern in the results: The osterisk (*) choracter motches ony bunch of characters while the question mork (?) motches ony single choracter. Note that "B." will motch ony file, olthough you might expect it to require the prefix end with o B.

What you have done with the DIR commond is testing how PC-DOS reacts to file nomes. DIR will list whichever files motch the nome you have selected. In PC-DOS. the space character is always a separator: this rule is different for the Apple computer, where o spoce con be used in file nomes

The COPY commond you tried to use octs like DIR, except that it takes two arguments. If the destination is a disk identifier like A:, then the orgument is read os A: *. *. Some exomples will help:

COPY A:*.BAS B:*.WIS-this will toke every file on drive A whose suffix is BAS ond copy it to drive B, while chonging the suffix to WIS. COPY A:*.* B:-this will copy every

file from drive A to drive B (except files that ore hidden, such as the PC-DOS system itself). COPY A:WS*.* B:-this will copy every file on drive A whose prefix begins

with WS over to drive B. COPY WS*.* B:-this will copy every file on the defoult drive whose prefix begins with WS over to drive B. The defoult drive is the drive identified by the letter preceding the > sign when you ore

in PC-DOS (that is, A> means A is the defoult drive).

COPY WS*.CO? B:-this will copy every file whose prefix begins with WS ond whose suffix begins with CO over to drive B. If B is the defoult drive you will

get on error messoge.

ANY PEOPLE wish to have their printers perform custom operations.

COPY WS.COM B:WS1-this will toke the file nomed WS.COM on the defoult drive and copy it to drive B under the nome WS1. If WS.COM is not found, o message to that effect will be displayed. The pracess of noming and copying

files is not o triviol one, ond it is well worth leorning. Certoinly, it is eosier to look at a short directory list generated by typing "DIR *.BAS" rather thon finding oll the BASIC code files in the list produced by typing DIR *.*.

Custom Control of WordStar

I get on omozing quontity of letters each month osking how to perform vorious tricks with the WordStar text editor. This prablem is porticularly ocute for people who don't hove Epson printers, who will find that the cookbook opproach given by vorious mogozines is not informotive.

I will describe how to moke your printer, whotever it is, jump through hoops with WordStar.

Mony people wish to hove their printers perform custom operations. To do this, the first step is to look through the printer monuol to find out which sequence of chorocters will couse that operation. As on exomple. I'll show how to do superscripting with the Epson FX-80. You turn superscripting on with this sequence: The ESCope chorocter (number 27, or hex 1B) followed by "So". You turn superscripting off by sending this sequence: ESCope "T". In BASIC, the instructions can be written os follows:

10 REM Turn superscripting on 20 LPRINT CHR\$ (27) + "Sg";

30 REM Turn superscripts off 40 LPRINT CHR\$(27)+"T":

If you know how to perform the operation within BASIC, you also can use WordStar to do the some thing.

WordStar provides you with four speciol purpose commands. They are Ctrl-O. Ctrl-W, Ctrl-E, and Ctrl-R. To embed the control character within text you type Ctrl-P (hold down the Ctrl key ond top the P key), then key in the chorocter (Q.W.E. or RI

When WordStar comes upon one of these contral chorocters while printing, it sends o text string out to the printer (os LPRINT does in BASICI.

You define the string by putting it into the WS.COM file. In order to tell WordStar how long the string is, precede the string by o number showing its length.

Soy I wont to hove WordStar send the string CHR\$(27)+"S0" whenever it sees o O. The string has 3 characters, so inside of WS.COM I will need to first place the number 3 and then the string. The loco-

tions are (in hexodecimol): Ctr1-0 = 077F Ctrl-W = 0784

Ctrl-E = 0789 Ctrl-R = 07BE

(I om ossuming you use WordStar version 3.24 or version 3.3. These locations mov differ for other versions of WordStar.) Now, to change the WS.COM file, place

the WordStar diskette in drive B and the PC-DOS diskette in drive A. Then respond to the prompts by keying in the underlined text:

(debug the file) A>DEBUG B: WS. COM

(enter the right string) -E77F 3 1B 'SØ'

(write the new file back)

(DEBUG will print a message bere)

(now exit) -Q

Now, whenever WordStar sees o Ctrl-O it will send 3 chorocters. Esc+"S0." to the printer. The E commond tells DEBUG you wish to enter information. The letter E is followed by the hexodecimal address (here 77F tells where to put the informotion) and then by the octuol doto to be ploced (3 for the number of characters, 1B for the bey value of the ESCope character. and the other 2 characters are "So"). The W commond just tells DEBUG to write the

file. The Q is o quit commond. Notice that with DEBUG you con enter orbitrarily complicated strings. If a number is entered not in quotes, DEBUG reads

it as hexadecimal. Anything in quotes is read os o letter. As onother exomple, to set Ctrl-W os o key to turn off superscripting, we go

through this sequence: A>DEBUG B: WS. COM

-E784 2 1B 'T'

 $-\overline{w}$

-0 A>

This string is only two choracters, so in the second line precede it by the number 2. Escape is hexodecimal 1B, and Ctrl-W is found of locotion 784.

If you wont to get custom reoctions from o printer other thon the Epson. just fill in the oddresses with the string you wish sent, preceded by the length, Seems eosy, doesn't it? Note that WordStar sets the maximum string length to 4 choracters (5 counting the length byte), so the string con't be too complex.

If four strings ore not enough, then you might wish to preempt the ribbon color changes (switched an and off by Ctrl-Y). These can be found at 0793 for Ctrl-Y on and 0798 for Ctrl-Y off.

For the FX-80 printer I use the on ond off states of Ctrl-Y as an underline commond. That wov underlining con work with ony font, including praportional specing and enlarged text. If you wish to use enlorged text, you might prefer to preempt the olternote font chorocters. Alternote font is selected by Ctrl-A ond deselected by Ctrl-N. The strings ore found ot 076B for Ctrl-A and 0770 for Ctrl-N.

If you use enlorged print, you should tell WordStar haw large your letters ore so It can justify correctly. The single value of oddress 037D is the size of each olternote chorocter in 1/120-inch units (0C hexodecimol = 12 decimol = 12/120" = 10 pitch: 0A hexodecimol = 12 pitch).

The PC Tutor solves practical problems and exploins points of general interest. If you'd like to see your questions answered here, drop o line to PC Tutor, PC Mosozine. One Pork Avenue. New York, NY /PC 10016

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CIRCLE 453 ON READER SERVICE CARD

EDITED BY BILL MACHRONE

Programming tips and insights into bugs are shared by members of the PC users community.

User-To-User

Come a Little Bit Closer . . .

WordStar creates potential problems when you use it for writing programs or for preparing files that are to be transmitted vio some telecommunications programs. When used in Document mode, WordStar sets the eighth bit of the lost letter of every word to denote where it can justify and odd "soft" spaces. In Nondocument mode, the eighth bit is never set. This "high" bit is not part of the ASCII character set and con cause a variety of strange occurrences when the file is used outside WordStar. The most obvious are the graphic and extended characters that oppear when o WordStar file is TYPEed on the screen.

Here's o simple and useful technique for eliminoting the high bit. In the back of your mind, keep the idea of using of lie with o length of 1 character. It can be a lifesaver for some otherwise impossible programming tosks.

Reading "Letters to PC" in the June 1983 issue, I learned that some users have difficulty converting WordStar files into ASCII ones. I would like to suggest a simple BASIC program that will do the job

(see Figure 1).

120

This program takes a byte from the input file, turns the eighth bit off, and writes it to the output file. The program can be further customized. For example, if you don't want to have WordStar control characters, type the following line:

95 IF B-8 0 r (B-32 and B-13) go to

You can also print an output file while in BASIC. In order to do so, add this line to the program in Figure 1.

105 LPRINT BS:

Boris Galinsky Brooklyn, New York

A problem with Colinsky's program is that it reads and writes one byte of a time. This is affective, but S-LO-W. Here, in Figure 2, is an adoption of his program that handles 128 bytes of a time. If you increase the buffer size to the string-handling maximum of 25s it will go fester still. The problem with the buffered promise that of the content of the file. On the content of the file.

Multikey Solution for Handicapped

Below is a very reasonable opproach to the problems forced by users unable to press more than one key of a time. Occom's rozor says that the simplest solition is the best one. Until symmone comes along with a lozzy system for toggling keys like Crit and All (with 28th line status messages) I recommend Anthony Sebastion's opproach.

I am suggesting a simple, effective, and reliable alternative method for toggling control keys (Shift, Cirl, and Alt) on the PC keyboard for persons who have physical disabilities that preclude pressing more than one key at a time. (See letter to "PC Tutor" from Dal Vordah, PC, Volume 2 Number 1, pages 74-75]. Using plastic

```
Figure 1: A program by Boris Galinsky that converts WordStar files into ASCII.
10 LINE INPUT "Enter input file name:": IN$
20 LINE INPUT "Enter output file name: "; OUS
30 OPEN IN$ AS #1 LEN=1
40 FIELD #1, 1 AS A$
50 OPEN OUS AS #2. LEN=1
60 FIELD #2. 1 AS BS
70
         GET #1
80
         IF EOF(1) THEN GOTO 130
90
         B-ASC(A$) AND 127)
100
         LSET B$=CHR$(B)
110
         PUT #2
120
         COTO 70
130 CLOSE
```

wrap, lead sbot, and wire twist ties, feshion two weighted bags, each large enough to completely cover a PC key when pleced directly on top of it. Position the shot bags on the keyboard just to the left of the vertical triad of control keys (Ctrl. Shift, Alt) in the valley between the control keys and the function key ped. The bags are "fluid," and it is relatively easy to "roll" one (or both) of them toward the right to depress. and keep depressed, one (or two) of the control keys. When you want to release the key (or keys), simply roll the weighted bag away. Thus, the control keys can be toggled.

I have been using this method of toggling the control keys on the PC keyboard for nearly a year and can ettest to its effectiveness for a physically disabled person who would otherwise type one key at a time, using a rubber-tipped mouthstick. Two bags suffice, since I have not found any applications that require simultaneous susteined depression of a triad of control keys. A little experimentation to get the bags just the right size is necessary, and the range of bag sizes for effective toggling Is considerable. The bags I use are large enough that as they rest in the valley between the function and control keys. they slightly overlep the left-hend edge of the control keys. Since they are fluid, it is easy to shift their center of gravity onto the control key. A few minutes experience is all it takes to learn how to use the bags effectively. It is not perceptively longer for me to toggle the control keys this way than

to toggle the CapsLock key.

Anthony Sebastian San Francisco, California

Auto Formfeed after BASIC Listings

This technique will work with any printer that uses ASCII 12 (FF) as the standard formfeed. You can't put o regular formfeed into a BASIC program because it clears the screen and abandons the line on which you are typing. 140 sets the high bit of the formfeed character (128 plus 12). which tricks BASIC into toking no oction on it. The high bit is stripped by PC-DOS when the character is sent to the printer. so the printer sees o true formfeed while

you get o circumflexed i on your screen. Doing a formfeed after LLISTing a BASIC program becomes a time-consum-Ing task on the IBM printer because you have to follow all of these steps:

· Reach over to the printer and hit the on-line button.

· Hit the form feed button. · And finally, when the printer has done its formfeed, the on-line button needs to be pressed again before print-

by following these simple steps. · Be sure the printer you bave is an IBM (Epson MX/80).

· Load your BASIC program to be LLISTed. Then type in 65529 REM FORM

FEED (don't bit enter yet).

Figure 2: An adaptation of Galinsky's program that handles 128 bytes at a time.

```
10 LINE INPUT "Enter input file name: ": INS
20 LINE INPUT "Enter output file name: "; OUS
30 OPEN INS AS #1 LEN = 128
40 OPEN OUS AS $2 LEN = 128
50 FIELD #1, 12B AS A$
60 FIELD #2. 12B AS CS
70
         LSET AS = STRING$(12B,&H1A)
         GET #1
80
90
         FOR X = 1 TO 12B
                  B$-B$+CHR$(ASC(MID$(A$,X)) AND 127)
120
         LSET CS = BS
         B$ = ""
130
170
         PUT #2
```

IF EOF(1) THEN GOTO 200

GOTO 80

180

190

200 CLOSE

 Type in Alt (and hold it down) while typing in 140 on the numeric keypad.

· Now hit Enter and LLIST away. Brad Thurber Fort Wayne, Indiana

ESPITE. the problems with PC-DOS 2.0. it provides some wonderful features for hacking around, customizing, and personalizing.

How Many Angels Can Dance on a Function Key

Despite the grawing list of problems with PC-DOS 2.0, it provides some wonderful features for hocking oround, customizing, and personolizing. Here Ronold Parsons makes use of the two of them, Most of these can be done automatically ANSLSYS and I/O redirection, to expand on the work done by Kenneth Wood in the June issue of PC.

The article, "Defining Function Keys with PC-DOS 2.0," mentioned that the Keyboard Key Reassignment (KKR) es. cape sequence had an undocumented limit of 128 bytes in its look-up table. The actual table limit is 190 bytes. The table. used to store the key redefinitions, contains a 1 byte length code followed by the string between the Esc [and the p delimiters for each key redefinition. For example, the sequence Esc [0;68;"dir";13p would be stored as the hex string 07 00 44 64 69 72 13.

The Debug procedure given in Figure 3 creates a copy of ANSLSYS with a larger look-up table. For ease in calculating the required numbers. I would recommend enlarging the table by a multiple of 80H bytes.

The expressions given in parentheses should be calculated and placed in the command without the perentheses. The length the table is extended is shown as xxxH. The numbers I used for enlarging my KKR look-up table by 200H bytes are shown near the right margin. My comments are in brackets

First make a copy of ANSI.SYS. Do not modify your original copy.

COPY ANSI.SYS ANSIX.SYS

Then enter Dehug, and issue the commands shown in Figure 3.

The entry in CONFIG.SYS should now be changed to DEVICE=ANSIX.SYS and the system rebooted.

A command file ANSIX.CMD to be used as redirected input to Debug is shown below. The lines changing the CS and DS registers must, of course, be changed to match your system. My CS on entry to Debug was A&A and I made ANSIX.SYS 200H bytes longer. Execute as: DEBIG ANSIX.SYS < ANSIX.CMD

This change will allow a much more re sonable KKR sequence to be defined. Ronald G. Parso Austin, Ter

Equal Time for EasyWriter Just to prove that we octually pay he to word processing packages other th WordStar, here is a simple procedure getting EasyWriter 1.1 to turn underlini

r cs a9a r ds 898 rcx RRO a cs:12 dw 809 a os:4ff mov cx.809 a cs:530 cmp bx,2c8 f cs:680 87f 0 m cs:600 67f 800 f cs:600 67f 0 a cs:842 mov word ptr [bx+0e].809 a cs:84a imp Ode rcs 280 r ds a8a q

on and off with an IBM Grophics Printer. Note that the general technique will work with any printer that provides enhanced print modes, just substitute the proper

print modes; just substitute the proper escope or control sequence. I have the IBM Graphics Printer and

have been trying to get EasyWriter 1.1 to use many of the capabilities of this unit, particularly for underlining words. Here is a technique I now use and it

works just fine. To send to the printer to "turn on" underlining mode is: Ctrl-O, then Esc, then hyphen(-), then 1. The

underfining mode will be in effect until you send a Ctrl-O, then Eac, then hyphen (-), then 0. While this works estifactorily, it does take up three character positions each time you toggle the mode on or off. So, if you wish to underline only one work on a line, six additional characters must be added. This will create some alignment problems, even though the sequence does

not affect the output.

I found a better way: defining USERn commands. At the beginning of the document I set .USER1[= Ctrl-O.Esc ...1 and

sarger sook-up taose.		
DEBUG ANSIX.SYS	{The program will be loaded at CS:100}	1
R	{Determine current CS, DS and CX}	
R CS		
(old CS + 10H)	{Compensates for the load offset}	A9A
R DS		
(old CS + 10H)	{Compensates for the load offset}	A9A
R CX		
(old CX + xxxH) A CS:12	{Sets file length to be written}	880
Dw (609H + xxxH)	{Fix pointer to initialization {RETURN to end assembly}	809
A CS: 4FF		
MOV CX, (609H + xxxH)	{Pointer to initialization} {RETURN to end assembly}	809
A CS:530		
CMP BX, (OC8H + xxxH)	{Table length} {RETURN to end assembly}	208
F CS:680 (67FH + xxxH) 0	{Fill extended table with zeros}	87F
M CS:600 67F (600H + xxxH) F CS:600 67F 0	{Move initialization code} {Zero old init code location}	800
A CS: (642H + xxxH)	(Fix pointer to initialization	842
MOV WORD PTR [BX + OE], (609)	+ xxxH)	809
	{RETURN to end assembly}	
A CS: (64AH + xxxH) JMP ODE	{Fix jump to main code}	844
	{RETURN to end assembly}	
RCS	{Restore original CS	
(CS: as it was on entry to de	(bug)	ABA
RDS	{Restore original DS}	
(DS: as it was on entry to de	bug}	A8A
	{Write the new file}	
0	{Quit debug}	

Figure 3: A Debug procedure by Ranald Parsans that creates a copy of ANSLSYS with a

.USER2] = Ctrl-O.Esc -,0, where "[" and "]" are unique symbols. All I have to do is use these symbols to designate the beginning and end of the text I wish to underline. This way only one character is needed to toggle the underlining mode.

This is the exact sequence: Type .USER1{ Press and hold the Ctrl key

Press the <u>0</u> key once
Release the <u>Ctrl</u> key
Press and hold the <u>Esc</u> key
Press the hyphen(-) key once
Release the <u>Esc</u> key
Press the 1 key once

Press Enter.

To "turn off" the underlining mode, follow the same procedure for assigning .USER2], but substitute 0 for the 1.

Raymond R. Hitney Putnam Valley, New York

Loading Like Lightning Irrepressible contributing editor Stephen Manes hos o big tip for oll of you who use the BASIC interpreter often. BASIC's internal storage formot tokes up nearly 20 percent less spoce on disk, and can, os Manes points out, load several times foster. You should, os o motter of course, make o distinction between files

WHEN

BASIC loads an ASCII file, it has to spend time—lots of time—

converting it to binary.

stored in BASIC's internol formot and those stored in ASCII. Use .BAS os the defoult for all internol formot files and .ASC for those in ASCII formot.

Got a favorite BASIC program that

takes 10 seconds short of forever to load from disk? Chances are it's been stored on the disk in ASCII format. When BASIC loads on ASCII file, it has to spend time lots of time—converting it to binary.

You can check the file by entering TYPE FILENAME when in PC-DOS. If you can read the program listing, it's in ASCII.

The solution? Simply enter BASIC and load the program one last interminable time. Then save it in normal binary form, using the command SAVE "FILENAME." From then on, it should load like lightning.

Stephen Manes Bronx, New York

Share Your Discoveries

Remember that "User-To-User" is your column. Send contributions to "User-To-User", PC Magazine, One Park Ave., New York, NY 10016. Please double-space all cantributions, provide clean copies of program listings, and include the nome of this department on your envelope.

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PC 1024 Graphics

Display A display utilizing a 20-inch tube, canable of producing 1024 × 780 dot screens. The unit operates on a high vidto bandwidth, enabling the user to create a non-interlaced picture in high resolution without flicker. White phosphors, instead of green, allow the display to be viewed under a wide variety of lighting conditions.

Pictures are drawn onscreen at a rate of one million pixels a second. In alphanumeric mode, 128 characters by 50 lines can be displeyed, and can be shown with graphics in

mixed mode. The unit incorporates an RS-232C interface, and can operate under PC-DOS, CP/ M-86 and UCSD n-System. Its interface board contains a real time clock/calendar and bus extension cable. (List Price: £4,300) Rivo Terminals Ltd. 9 Woking Business Pk. Albert Dr. Woking, Surrey, U.K. (04862) 71001 Telex: 85 9502 CIRCLE 777 ON READER

Color Graphics Board A plug-in board incorporating an Intel 8088 co-processor chip and e NEC 7220 VLSI graphics controller

SERVICE CARD

chip to provide graphics with resolutions of up to 1024 by 1024, two planes of memory (4 colors available). RGB and composite video outputs, and a light pen interface in the minimal configuration. Optional configurations

allow the user to choose an additional third and/or fourth level of memory for up to 16 colors displayable simultaneously; a color look-up table option allowing the user to choose up to 16 colors from a palette of 4098: a mouse interface for graphics input; and an RS-232C port option allowing the on-board co-processor direct eccess to a plotter or digitizing tablet. (List Price:

Basic board \$995: in optionol configurations, up to \$1,995) Frontier Technologies Corp. P.O. Box 11238 Milwaukee, WI 53211 [414]984,8689

CIRCLE 787 ON READER SERVICE CARD

IBM 8087 Math Co-Processor

A specialized chip which. when installed on a user's system board, significantly increases the speed at which floating point arithmetic, logarithmic and trigonometric functions are processed. The option kit contains both the 8087 and a current level 8088 chip to ensure high

performence of the co-pro-

cessor is maintained be-

tween the two chips. To take edvantage of the

8087's capabilities, software designed specifically for the co-processor is required. (List Price: \$260) I.B.M. Corn. Systems Products Div. Entry Systems P.O. Box 1326 Boca Roton, FL 33432 (305)998-6007 CIRCLE 789 ON READER SERVICE CARD

Submissions to "New On The Market" Inclusion in "New on the Market" is at the exclusive discretion of PC Mogazine cannot guarantee publication of a product

PC Magazine cannot guarantee publication or a product association for a particular issue. In any case, submissions of amouncement for a particular issue. In any case, submissions of material for "New on the Market" must be received no later than magnat for 'New on the Market' must be received no later than seven weeks in advance of the first week of the issue month. For seven weeks in advance of the first week of the issue month. For example, for the August issue, all material must be in our hands no example, for the August issue, all material must be in our bands no later than the middle of June, approximately 2 weeks before the ad closing date

Submissions must include retail price, distribution methods, and Summerons must include reall price, distribution methods, and details of required hardware and software. Include a phone contact The details for the product announcement should be submitted in typewriten form, double-spaced on one side of the paper. Postrier ports, acoustic-spaces on one state or one paper:

minorer possible, include 8x10 glossy photograph of the product Whenever possess, section on to grossy prioring april in black & white or color. If applicable, include screen In mack & write or conor, it appraisance, incroase screen photographs. For best quality, direct camera screen images are preferable to photographs from the monitor.

All material should be sent to: New on the Market, PC Magazino, 1 Park Ave., New York, NY 10016.

New On The Market

Interfazer

A universal controller/buffer device capable of controlling the printing jobs of up to eight systems, on two printers. Interfazer can accept the printer output from one to eight computers through either serial or parallel I/O cards, and can store up to 128,000 characters in its buffer memory. Output to the printer can be parallel or serial, and baud rates from the computers need not match the rates into the printers.

an 8065 microprocessor, and contains eight input slots and two outputs. It operates on a priority data basis (first data in, first out), and can also serve the user as an interface for incompatible equipment, computer I/O expander, dats transfer rate converter, and additional peripheral buffer, (List Price: Bose unit \$295; each odditional 64K of memory \$295; parallel I/O or seriol I/O cords \$65 each) Quodram Corp. 4357 Pork Dr. Norcross, GA 30093 (404)923-6666 TWX - 810-766-4915 CIRCLE 780 ON READER SERVICE CARD

The unit is based upon



Quodscreen, Quodram Corp.

Ouadscreen

A display monitor measuring 17 inches diagonally, canable of displaying up to 10.240 characters onscreen at one time. Character configuration in text mode is either 120 characters by 64 lines using an eight-by-eight dot matrix, or 160 characters by 64 lines using a five-byseven character metrix. Quadscreen slso offers two full screens of memory of 64K each, and bit-mapped graphics resolution capabili-

ty of 968 dots by 512 lines. Additional features include reverse video and forward/backward scrolling. The controller board fills one expansion slot, (List Price: \$1,995) Quadram Carp. 4357 Pork Dr. Norcross, GA 30093 (404)923-6666 TWX: 610-766-4915 CIRCLE 781 ON READER SERVICE CARD

Quadcolor Boards

A plug-in board allowing bit-mapped high resolution graphics in up to 16 colors to be displayed. Two Quadcolor video boards are availsble. Ousdcolor I is hardware and software compatible in text mode with the IBM Color/Graphics Adapter. Ousdcolor II allows bit mapped resolution of 640 × 200 pixels in 16 colors.

Each Quadcoior board will drive most RGB or composite video monitors, and will support text, (List Price: Quodcolor I \$295; Quodcolor II \$275) Ouodram Corp. 4357 Park Dr. Norcross, GA 30093 (404)923-6666 TWX: 810-766-4915 CIRCLE 774 ON READER SERVICE CARD



Printek 900 Series Printers

Three dot-matrix printers with automatic bi-direction al printing, graphics capabilities, and an internal 1,800 character buffer. Model 910 offers speeds up to 200 characters per second in high speed mode, 22 software-controllable functions. eight character sizes, and seven foreign character sets in addition to its standard 96 ASCII character set. The 920 offers the same features. but with speeds up to 340 cps and two 8K buffers. Modei 930 has a user-selectable dot density of 72 dots per inch in addition to the 144 dots per inch density available in graphics mode in all three models

All units feature both RS-222C serial and Centronicstype parallel interface ports, baud rates from 300 bps to 9,600 bps, switchable parity settings, and can handle continuous forms, or cut sheets with optional feeders. (List Price: Model 910 \$1,595; model 920 \$2,395; model 930 \$1,995) Printek, Inc. 1517 Townline Rd. Benton Harbor, Mf 49022

(616)925-3200 CIRCLE 779 ON READER SERVICE CARD Advanced Communications Board

A communications board providing multiple protocol support capability (Sync. Async., HDLC, SDLC, CCTIT-X-25), user-selectable DTE/DCE configurations, and switchabble device addressing. Available options include a real time clock/calendar with battery back-up, and a parallel port.

In async mode, the board offers programmable baud rates from 110 through 19.2K, automatic error checking, programmable word lengths and stop bit lengths, and modem control

signal output. Sync mode features include automatic address field recognition, null, abort, CRC generation, CRC checking commands, as well as zero and sync-char-

went as zero and sync-classacter insertions and deletions. (List Price: \$275, options \$40 each) Frontier Technologies Corp. P.O. Box 11238 Milwoukee, WI 53211 (414)964.8889

CIRCLE 786 ON READER SERVICE CARD IEEE-488 Controller A board allowing up to 15 devices to be controlled through a standard IEEE-48s bus connector. The board performs controller, talker, and listener functions, and can link devices such as frequency generators, multimeters, speech synthesizers,

IEEE-compatible equipment to the user's system. A real time clock/calendar with battery back-up, and an RS-232 port are available as options. (List Price: \$395; options \$40

power supplies, and other

each)
Frontier Technologies Corp.
P.O. Box 11238
Milwoukee, WI 53211
(414)964-8689
CIRCLE 78S ON READER
SERVICE CARD

900 Series Printers Printek Inc.



New On The Market

I-Bus Six Pac

An expansion chassis ellowing up to six additional function boards to be edded to a user's system. The chassis contains a 40-wait power supply and backplane with six elost. It is usable with virtually all PC-competible boards, including RAM, floppy and bard disk interfaces, communications, and printer I/O boards.

Connection to a user's system is by shielded interfoce cable, evaliable in either an 18-inch length. An included interface card requires one slot in the user's system. (List Price: 18° coble \$695; 48° coble \$755)
1-Bus Systems
8863 Bolboa Ave.

CIRCLE 778 ON READER SERVICE CARD

Six Pac Expansian Chassis, I-Bus Systems

San Diego, CA 92123

(619)589-0646





SC817 Smart Cable, IQ Technologie

Model 358 Printer and Optional Sheet Feeder A new addition to the Printstation 350 Series of printers, the Model 358 dot matrix printer provides bi-directional high speed draft printing, multi-pass correspondence quality printing. and four color or seven color print capability. Other features include a liquid crystal display providing printer status and feeture selection, e 20-million charecter one-inch wide ribbon. and a rotary ribbon shifting mechanism designed to enbance color clarity and eccuracy.

Other standard feetures include cut sheet and fanfold peper bandling ebilities, both serial and parallel interfaces, pin-eddresseble grephics, self-diegnostics, and superscript/subscript printing.

Aveilable es an ontion. the Autometic Sheet Feeder attachment uses peper/ forms/envelope cassettes which allow the user to configure the feeder for one two, or three bin operation The unit automatically feeds sheets and envelopes in the proper sequence as controlled either by the user's system or through settings on the printer's control panel. (List Price: 358 Printer \$2 995: Sheet Feeder \$795) Centronics Dato Computer Corp. Hudson, NH 03051

Hudson, NH 03051 (603)883-6505 Telex: 94 3404 CIRCLE 749 ON READER SERVICE CARD SC817 Smart Cable
An RS-232 interface cable
incorporating logic circuitry.
The cable eliminates the
need for custom cables to
link peripherals to a user's
system, as its circuitry is capable of connecting all
handshake lines used in a
specific application. The
SC817 Smart Cable can
function at baud rates up to
19,200.

The three state logic circulty includes a "test" circult, which characterizes the interfaces to which the cable is connected. In the event a connected device is hampering operations, an indicator light points out which device is at fault. A "pattern comparator" circuit determines the cornect interconnect pattern required for the application, and activates the eppropriate interconnect circuits to complete the concircuits to complete the con-

operation include positive voltage, negative voltage when driven by output circuits, or tendency to zero volts when driven by input circuits. (List Price: \$62.95) [Q Technologies, Inc. 11811 N.E. First St. #308 Bellevue, WA 98005 (206)451-0232 Telex: 70 1472 CIRCLE 771 ON READER SERVICE CARD.

The cable's three states of

SERVICE CARD

nection.



Daisy Systems M45

A daisywheel printer featuring as options both an RS-232 interface module and a switch-selectable interface module for RS-232, Current Loop, Centronics, and Data Products connections. The printer can run with different types of systems by switching the interface module's settings.

Other features of the printer include proprietary print hammer with seven printing intensities, and a separate motor drive for the ribbon cartridge that lessens the need for frequent ribbon replacement. (List Price: \$1,995)

Daisy Systems
P.O. Box 1010
Torrance, CA 90505
(800) 4A-DAISY
(800)441-5273 in Calif.
CIRCLE 788 ON READER
SERVICE CARD

Easiboard

A plup-in board incorporating 11 functions. The multifunction board contains Easisort, allowing sorting of deta; Easispool, a printer buffer/spooler; three Easidisk electronic disk drives emulators that operate et faster processing rates than normal disk drives; Easitime and Easidate, providing clock and calendar functions respectively; Easiswap, allowing the user to switch between two printers linked to the same system; a parallel printer interface; a communications port for modems or additional printers; and memory expansion

of 64K or 256K RAM.

A software package, Eosimoster, is included with the Easiboard (List Price: Bosic model \$325) Easitech Corp. 2215 Perimeter Pk., # 22 Atlanta, GA 30341 (404)452-7576 CIRCLE 770 ON READER SERVICE CARD

Monte Carlo GT and Quatro Boards

offering 64K to 1M byte of RAM, a clock/calendar with 13-year back-up battery, an RS-232 port, and a Centronlos-type parallel port. In addition, the GT board offers adapters for use with two lovsticks.

Both boards offer disk drive-emulating software, as well as on-board diagnostics capabilities. (List Price: Quotro \$375; GT \$425; odditionol RAM ovailoble of opproximotely \$60 per odded 64K)

Micro Business Industries Corp. 1019 Eighth St.

Golden, CO 80401 (303)279-8438 TWX: 910-934-0191 CIRCLE 783 ON READER SERVICE CARD

Monte Carlo GT Board, MBI Corp



New On The Market

MULTIBUS Adapter
An adapter to link the user's
system with the IEEE 796
standard MULTIBUS. The
device consists of two cards.
One fits a slot in the user's
system, the other fits into a
MULTIBUS card cage. The
two cards are intercon-

nected with flat cable.
Address mapping is provided to directly address up to 255K bytes of MULTIBUS memory. The user can establish the resulting target address in MULTIBUS address space by DIP switches. Another set of switches selects the range of MULTIBUS I/O addresses that can be accessed by the user's switches.

cessed by the user's system The MULTIBUS Adapter contains 6K bytes of static RAM, which can be mapped into any unused address space in either the user's system or MULTIBUS. The RAM is a dual port concurrent access memory, and both the user's system and MULTIBUS can access the RAM simultaneously. The 8K static RAM provides memory or a DMA buffer for MULTIBUS use, (List Price: \$9951

\$995) Bit 3 Computer Corp. 8120 Penn Ave. So. Minneapolls, MN 55431 (812)881-6955

(812)881-6955 CIRCLE 776 ON READER SERVICE CARD

MasterGraphics Adapter

A single card that replaces three IBM graphics adapters-Monochrome Display and Parallel Printer, Color/ Graphics Monitor, and Parallel Printer, MasterGraphics functions include a palette of 4.096 colors, MosterSet software and hardware to allow users to create their own character generators, and a Dual Display kit for simultaneously linking an RGB monitor and an IBM Monochrome display to the same system.

The MasterGraphics
Adapter 1 provides four
times the storage capacity of
IBM adapters, increases ective colors from four to 16,
and can provide resolutions
of 640 × 200 in 16 colors
and 780 × 340 in high-res
monochrome. (List Price:
\$579)

Micrographics Technology Corp. 1820 McCarthy Blvd. Milpitas, CA 95035 (408)996-8423 CIRCLE 791 ON READER

SERVICE CARD



Messenger Interfoce Module, Smith Corono

Portable Typewriter/ Printer and Interface Module

A portable typewriter that can also serve as a letterquality computer printer when linked to a user's system through a Messenger Typewriter Interface Module. As a typewriter, the Memory Cornet III Messenger features full-line correction, with automatic relocation to original position after correction: multiple pitch for 10, 12, or 15 charteres per mech specing; and revarue tab to skellitet set.

tistical typing.

With the Messenger Interface Module, the unit is converted into a computer printer with the same features as in its typewriter mode, including sutomatic centering and underlining. The Module is provided with both serial and Centronics parallel outlets.

Available options for the typewriter printer include ten daisywheel type styles. (List Price: Typewriter \$599; Interfoce Module \$170) Smith Corona, Inc. 85 Locust Ave. New Canaan, CT 08840 (203)872-1471

CIRCLE 772 ON READER SERVICE CARD

SOFTWARE

PC Calculator and Programmable PC Calculator

Two programs which act as 16-digit calculators, with all key function definitions visible on-screen. Various display options included with the program, as well as printout formets, are selectable by the user. The numbers in 26 working registers are visible on the screen during calculations.

Programmoble PC Calculotor can creete and access over 250 calculation programs, each up to 102 steps in length. During programmine and editing, all program steps are on displey, and editing allows step by step deletion or insertion. During e program run, a routing indicator follows the progress of the calculation through the program's steps.

In addition, a package of widely-used financial functions is available as an option for the Programmoble PC Colculotor program, (List Price: PC Calculator \$29.95; Programmoble PC Colculotor \$49.95; lotter with Financial pockoge \$59.95) Requires: 64K, one disk drive, 80-column display. CTEK Corp. 748 E. Colorodo Blvd. Posodeno, CA 91101

(213)795-7877 CIRCLE 707 ON READER SERVICE CARD

Micro-FRS

An asset/liebility menagement program end Financial Results Simulator for banks and sevings and loan associations with assets up to \$5 billion. Features include a Target Balance approach whereby the user enters balance sheet goals and the program computes new volumes necessary to meet the goals; a rete generator facility; Gap Analysis Reports provided on both e static and dynamic basis for current and future periods; and the fecilities to print out Call Reports Schedules J. (List Price: License and ongoing use fees range \$3,500

to \$11 5001 Requires: 128K, two 320K disk drives, MS-DOS, or CP/ M-86, 132-column printer. Sendero Corporotion 4815 North Fourteenth Pl. Phoenix, AZ 85014 (602) 279-0401 CIRCLE 699 ON READER

SERVICE CARD

System Manager Vers. 1.0 & 2.0

A program providing users with e menu of DOS commands with which the user can access eny of up to 12 applications programs with e single keystroke. The program can run any .COM file (WordStor, dBASE II, etc.) or BASIC file. Resident utilities return control to main menu eutometically after an epplication program has run. In addition, the System Manager provides password security, one level in the PC-DOS 1.0 version, and three levels (down to DOS security) on the 2.0 version. The PC-XT version of

System Monoger allows up to 20 applications programs to be selected from a user-The utility program is definable menu, and makes supplied on magnetic tape use of tree-structured direcand on appropriete disks. tories, allowing the operator to create and access subdirectories on a hard disk. In eddition, the PC-XT version provides function key macros. "point and do" cursor control commends, as well as basic utilities. (List Price: Both versions \$89 each) Requires: Version 1.0: 64K. two disk drives, PC-DOS 1.0: PC-XT Version: 128K. Hard Disk, PC-DOS 2.0. **Business Monogement Sys**tems, Inc. 9526-A Lee Hwy.

Foirfax, VA 22031 (703)591-0911

SERVICE CARD

CIRCLE 711 ON READER

A file transfer utility allowing files to be transferred to or from a mainframe system. The program consists of two parts, one for a mainframe system operating under TSO or VM/CMS, and a part for a user's system running PC-DOS or CP/M.

FTP contains a levered protocol, including full Cyclic Redundancy Checking and eutomatic entry to ensure data integrity at high line speeds. Its micro component contains an asynchronous terminal emulator. which allows the user to dial the mainframe system. connect to TSO or VM/CMS. and issue either an Upload or Download command.

(List Price: \$4,000, including up to 10 copies of the micro version: additional micros at \$50 each) Requires: 64K, one disk drive, PC-DOS, monitor, seriel interfece, modem. On-Line Business Systems, 115 Sonsome St. San Francisco, CA 94104

(415)391-9555 CIRCLE 708 ON READER SERVICE CARD

New On The Market

PROJECT SCHEDULER and BAR GRAPH GENERATOR

Two utility programs to display data or graphs without requiring a color/graphics adapter board in the user's system. DATA SCHEDULER allows projects to be displayed, showing up to seven different tasks (sub-projects) at one time. Data is displayed on a day-by-day basis and shows the length of each task to be performed; whether it is firm or a proposed task; and who has responsibility for the completion of each specific task. Projects can be as long as two years, and up to 10 weeks of data can be displayed at one time.

BAR GRAPH GENERA. TOR allows the creation of bar graphs to display statistical information without programming. The user is sented with a fill-in-theblank screen and is asked to describe the graph and enter data. Screen displays one to three graphs simultaneously, in a choice of three formats with up to 15 time periods represented. (List Price: \$35 each)

Requires: 64K, one disk drive, monochrome monitor. DATA*EASY Software 877 Bounty Dr., # EE203 Foster City, CA 94404 (415)571-8100 (415)349-4001 CIRCLE 712 ON READER

SERVICE CARD

MergeCalc, LoadCalc, and DocuCalc

Three enhanced function programs for use with Visi-Calc or 1-2-3 spreadsheet programs. MergeCalc allows the user of a spreadsheet program to consolidate. merge, and manipulate different models without affecting the integrity of the data within each model. The program allows addition, subtraction, multiplication. or division of up to 15 models at one time, on files in

/SS. DIF. or WKS formets.

LoadCalc can read simple text files and convert them into a form necessary for manipulation by, or incorporation into VisiColc or 1-2-3 models. Text files can be captured with communications programs such as VisiTerm or R/Net, then loaded into the spreadsheet program directly, without special reformatting or programming. Fractions, such as those that appear on Dow-Jones data, are interpreted and converted automatically into decimals.

DocuCoic can print any section or all of a user's spreadsheet model in seven formats. It can show a model's equations, labels, and values in a grid layout, preserving orientation. One grid format wraps long equations so that they remain in their correct positions and are not truncated. Another moves long equations to the end of a report, and a third shows just a single reference letter for each column (E for equa-

tion, L for label, etc.) and shows columns A through BK on a single page. Single cell per line reports can be by row or column, with attributes in English (e.g. Two Decimal instead of /F\$). DocuColc can also detect and report any forward or circular reference which may cause erroneous results in a model. (List Price: MereeCaic \$125: LoadCaic & DocuCoic \$95 each) Requires: 96K (MergeCalc: 128K), one disk drive, PC-DOS, Visicale or 1-2-3. Micro Decision Systems P.O. Box 1392

Pittsburgh, PA 15219 (412)276-2387 CIRCLE 713 ON READER SERVICE CARD

STATGRAPHICS.PC An interactive data analysis and statistical graphics program, containing over 200 numerical and graphics

functions. The program consists of 30 workspaces, including a core workspace containing basic system functions used by most procedures. Individual statistical procedures are then copied into the active workspace from one of 26 available through the program's main menu.

The program includes a

general interface to control attached pen piotters, configured for the i R M XY/ 750 but adaptable to other plotters. For systems with both monochrome and color/graphics monitors, the program allows the user to separate text and graphics output. All input and text output is produced on the monochrome monitor, while all graphics output is displayed on the other. (List Price: First User's License \$475: odditional licenses \$80 each) Requires: 192K, one disk drive, PC-DOS, color monitor, color/graphics adapter, serial adapter board. Statistical Graphics Corp.

P.O. Box 1558 Princeton, NI 08540 (609)924-9374 CIRCLE TIS ON READER

SERVICE CARD



Total Materials & Total Inventory, TCS Software

TCS TOTAL MATERIALS & TOTAL INVENTORY Programs

Materiels/parts trecking and inventory control programs for manufacturing plants, intended to be used together as a system. The programs ellow the user to determine quantities of parts in stock, the number of finished goods that can be produced with the parts currently on hand, end can generate several types of bills of materials and production reports. In addition, the programs will eutomatically update inventory items as parts are used or replaced.

Current inventory levels can be maintained on an item-by-item basis for all raw meteriels, work in progress, end finished goods. The two programs used together include reports on productivity, meteriel requirements planning. new product development and engineering changes. and production cost analyses and reconciliations.

TOTAL MATERIALS also provides such information as reference numbers for engineering drawings and parts list numbers, next higher assembly, user comments, and page references to relate multiple essemblies to the finished product. (List Price: \$500-\$1,200 for each program, depending upon dealer support) Requires: 64K, one disk drive, PC-DOS. TCS Software Inc. 3209 Fondren Houston, TX 77063 (713)977-7804 CIRCLE 750 ON READER SERVICE CARD

PeachFix and Stock Price Catalog

Designed to be used with I.B.M./Peachtree Accounting software. PeachFix ellows the user to plece version 1.0 progrems on a single 320K disk, elimineting the need to change disks each time a new menu is required. In eddition. PeochFix can obtain such information as dete end time eutomatically from the system's DOS, precluding manuel entry of such information each time an application is run.

Stock Price Catolog, intended for use with LB.M./ Peachtree's Accounts Receivoble program, version 1.0. mainteins e perpetual inventory of items in stock. It allows the user to autometicelly track quantities of materials on hend prior to invoicing, generate out-ofstock and stock reorder reports, and monthly profitability reports for each item in stock. The program can support an inventory of up to 3,100 separate items identified by a 1-to-15 character LD. number. (List Price: PeochFix \$24.95: Stock Price Catalog \$495) Requires: 64K, two 320K disk drives, PC-DOS 1.1. LB.M./Peechtree softwere. version 1.0. Micro-Comp Business Enterprise, Inc. 5021 Kurt Ln. Convers, GA 30208 (404)922-6319 CIRCLE 775 ON BEADER SERVICE CARD

Peerless AgriSystems Programs

A series of programs designed for farmers and agribusinesses. The progrems include Crop and Field Management, Livestock Management, and Grain Elevotor Management, among others. The programs are integrated with each other. and with the Peerless Accounting and Management Anolysis System, e financial management system which allows for both book value and fair market value accounting simultaneously, as well es unlimited Enterprise Accounting with TEFRA and GAAP compliance. Future releases within

include programs for specific farming applications and farm types, soil types and fertilizer formulations, regionel variances and crops. (List Price: \$500- \$1,800, depending on module) Requires: 128K, two disk drives PC-DOS Peerless AgriSystems Softwore Div. Box 10339 San Antonio, TX 78210 (512)533-1274 CIRCLE 710 ON READER SERVICE CARD

the AgriSystems series will

New On The Market

PolyLibrarian

A software development tool for programming usine PcDOS (MS-DOS) operating system. PolyLibrarian organizes releted object code modules (OBJ files) into a single library (LIB file). The IBM PC Linker can then automatically select only the modules needed to contruct an executable program.

PolyLibrarian works with any compiler or essembler that uses the IBM PC Linker. Programmers can reduce code size, simplify structured programming, construct libraries, or examine and reorganize existing libraries. (List Price: \$99) Requires: 64K, one disk drive, PC-DOS. Polytron Corp. P.O. Box 787 DS 2-203 Hillsboro, OB 97123 (503)640-2875 CIRCLE 726 ON READER SERVICE CARD

Super*List Monoger,



SUPER*LIST MANAGER

A database management program incorporating sort/ select functions and e word processing system. The program's structure utilizes predefined formets, record leyout, and item definitions. SUPER*UST MANAGER ellows the user to print display screens with a single keystroke. Its sort/select function in the program of the pro

SUPER*LIST MANAGER ellows the user to print display screens with a single
keystroke. Its sort/select
function selects through up
to 2,400 records using eny
database item on file, with
up to four levels of selection
criteria.

The word processing
functions allow the user to

The word processing functions allow the user to compose and store up to 15 formatted reports, to combine form letters with names and addresses stored in the detrebase component, end to edit existing letters or create new ones. SUPER-UST MANAGER can be used for such applications es warranty records, subscriber lists, real estate listings, personelized records, word processing, and direct mell. (List

ing, end direct meil. (List Price: \$249) Requires: 64K, two 320K drives, PC-DOS 1.1, monitor, printer.

tor, printer. Pinnocle Softwore Systems P.O. Box 1220 Ft. Collins, CO 80522 (303)224-5061

CIRCLE 721 ON READER SERVICE CARD

MUSE

A word processing program capable of printing out documents exactly set they oppear on euer display. MUSE features include a spelling checker; a melling lest processing capability, an abbrevistion glossary; column move, copy end erase; decimel tubes hyphemetrois; copying and moving of portions of documents and a high speed cursor move high speed cursor move enert control system.

Mont advanced feetures include cursor-controlled document selection and deletion, a document recovery fecility, and document encryption. MUSE elso offers the user the flexibility of converting MUSE fles to DOS fles, of customizing menus and dictionaries, and of eccessing MUSE in several different languages. (List Price, 5899 Sec. Very 200K, two 200K, States Price, 11 or 2.0 K. States Price, 12 or

monitor.
MARC Softwore Internotionol, Inc.
260 Sheridon Ave. #200
Polo Alto, CA 94306
(415)236,1071

Polo Alto, CA 94306 (415)326-1971 TWX: 910-373-2013 CIRCLE 735 ON READER BasicWindow

A progremming development tool that allows BASIC application programmers to generate customized screens for new programs. Bosic-Window consists of e Screen Editor, for designing end entering custom screens; e Screen Driver, which the user includes in BASIC applications programs to perform BosicWindow operations; and a Mecro Processor, which can trenslete the BosicWindow request statements in the user's epplication into actual BASIC state. ments.

ments.

To eccess and use e screen in an application, the user includes Bosic/Window macro stetements into his BASIC program, end compiles the program using the included Bosic/Window Mecro Compiler. The result is a copy of the user's program with all of the Bosic/Window commands translated into standard BASIC language stetements. (List Price: \$89.95)

standard BASIC language standard BASIC language statements. (List Price: \$99.95)
Requires: 54K, one disk drive, PC-Dos, 80-column monitor, BASICA or BASIC Compiler. G. Freeman & Co. Softwore Design Group 15 Albin Rd. Stomford, CT 06902 (203)327-9862

CIRCLE 752 ON READER

Peeks 'n Pokes for the I.B.M. Personal Computer A collection of 50 programs, sight utilities, and techpiques for programmers to

niques for programmers to perform functions otherwise unavailable from BASIC or Pascal. The package includes a disk and 38-page manual, illustrating the use of BASIC PEEK, POKE, INP. and OLT functions to access and modify system information. Also included are general-purpose assembler subroutines used to perform DOS and BIOS function calls, read the file directory. and determine the amount of space on a disk that has been used and that is still

For the Pascal programmer, assembler subroutines that perform the same functions as those listed above are included. Sample programs demonstrate the use of these functions and the use of the DOS/BIOS subroutine.

available

Eight utilities are included on the disk to perform such functions as clearing the screen, swapping monitors, and displaying date and time. (List Price: \$30) Requires: 64K, one disk drive, PC-DOS, 80-column monitor.

monitor.
Data Base Decisions
14 Bonnie Ln.
Atianta, GA 30328
(404)256-3860
CIRCLE 717 ON READER
SERVICE CARD



Peeks n' Pokes, Dato Bose Decisions

UltraTRAP A parity error handling util-

ity program designed to reset the parity error detection circuitry and report the condition to the user via the monitor instead of halting the machine.

UltraBOOT, a dynamic memory allocation utility, and UltraFATs, flexible disk RAM emulator, are also included. (List Price: \$39.95) Requires: 64K, one disk drive, PC-DOS 1.1. Doystor Systems, Inc. 10511 Church Rd., #L Dulles, TX 75238 (214) 341-63136

CIRCLE 720 ON READER SERVICE CARD Entrepreneur Software

Series A series of six software

A series of six software packages, consisting of Visi-Calc templates and files in DIF format. Designed for use in starting up new small to medium-sized businesses, the programs are keyed to 200 business books, covering specific industry information for a range of small businesses.

Puckage ONE, for 30
"business service" businesses, cover consulting
firms, print shops, publishing, video production, employment and travel agencies, advertising, seminar organizing, among others.
Package TWO works with
30 books aimed at "consumer service" Belds, such as
day care centers, car rental
agencies, coin laundries, automotive services, and similar services.

Package THREE, used with 24 books, covers the food and Leverage industry. FOUR deals with 20 businesses with unique facilities requirements, such as physical fitness centers, video ercades, and dance studios.

Pockage FIVE is aimed at retail merchandizing, and examines the operations of more than 50 different businesses. SIX is designed for use by those interested in up to 50 low start-up cost businesses, such as mail order, street vending, craft sales, and the like. (List Price: \$75-\$95, depending on package) Requires: 64K, one disk drive, VisiCalc. Entrepreneur Magazine 3211 Pontius Ave. Los Angeles, CA 90064 (213)478-0437 CIRCLE 722 ON READER

SERVICE CARD

New On The Market

L.I.F.E. Goals

A financial investments analysis program allowing professional investments advisors to produce a detailed. custom Financial Plan for each of their clients. Plans produced by the program run 18 to 26 pages, and consist of explanation and analvsis of the client's present and proposed financial situ-Analyses generated in-

clude a financial statement, monthly budgeting profile, investment performance. college funding needs, effects of inflation, life insurance needs, retirement capital needs, asset diversification, Individual retirement accounts, five year tax planning, and home refinancing. Federal income tax and Social Security retirement and survivor benefits are automatically computed. (List Price: \$945) Requires: 64K, two disk

drives, CP/M or MS-DOS. SuperCalc, WordStar, Mail-Merge programs. Kinnaird SoftPlans 2953 N.E. Brogden St. Hillshorn, OR 97123 (503)840-2875 CIRCLE 737 ON READER

SERVICE CARD

The Work Management System

A program designed to assist field operations managers in work scheduling. evaluations, and productivity, to help justify capital expenditures, allocate resources, and develop work plans. The Work Management System is intended primarily for use by municlpalities, and can provide data in both work backlog and work performed for such areas as streets, sanitation, parks, buildings, utilities, airports, and traffic control. It can be adepted for use in plant and facilities maintenence, grounds maintenance, and construction work. (List Price: \$3.950, including perpetual license, technical installation, and six manths softwore mointenance) Requires: 128K, 2MB Hard

Disk, PC-DOS, dBASE II. LWFW Group 12700 Park Central, #1805 Dallos, TX 75251 (214)233-5561 CIRCLE 755 ON READER SERVICE CARD



Decision-Analyst, Executive Software

Decision~Analyst

A program providing businessmen with the ability to analyze complex problems where there are many alternatives and/or criteria to be examined and evaluated.

The program takes the user through eight menu-selected sections including problem definition, statement of decision purpose, establishing and weighing of "want" and "must" criteria, calculation of critical values, defining elternetives, weighting and scoring alternatives against criteria, assessing possible edverse consequences, and final conclusions and choice (List Price: \$139) Requires: 96K, one disk drive, CP/M-86 or PC-DOS. 80-column monitor, 80-column printer. Executive Softwore, Inc. Two N. Stote St. Dover, DE 19901 (705)722-3373 CIRCLE 725 ON READER SERVICE CARD

4CaST/1 A business forecasting program incorporating eight different techniques, with the capability of displaying forecasts in color graphics. Transform utilities allow the

user to develop custom forecasting techniques to add to those pre-progremmed. 4CoST/1 can be linked to spreadsheet programs such as VisiCalc, and can accept data downloaded from

mainframe systems, (List Price: \$7251 Requires: 128K, one disk drive, PC-DOS, color/graphics adepter, monitor. HEURIX Computer Products P O Rox 9227 Morristown, NJ 07960 (201)267-2806 CIRCLE 740 ON READER

SERVICE CARD

PEAR Technical Analysis An investment analysis pro-

gram that can help a user identify profitable strategies for trading and investment. The program is divided into subcomponents that provide graphics, modeling, evaluation, and data retrieval.

With PEAR Technical Analysis, the user can create decision rule models, evaluate the performance of models over any time period. and analyze price data using a range of graphics generat-

ing capabilities. Automatic pricing data can be obtained through DIAL/DATA, which gives users access to the Merlin detabase of daily and historical price information for securities, commodities, stocks, options, bonds, government issues, mutual funds, and financial futures. (List Price: \$1.450; DIAL/ DATA prices variable, depending on dota requested) Requires: 128K, two disk drives, PC-DOS or p-System, Hayes Smartmodem. Remote Computing Carp. 1076 E. Meadow Cir. Palo Alto, CA 94303 (415)494-6111 CIRCLE 783 ON READER SERVICE CARD

Personal Computer Data Interface (PCDI)

An integrated telecommunications, database management, and graphical analysis program, PCDI is configured to communicate with IRM's VM/370 operating system, though it may be modified for other systems. The program can automatically retrieve data from a mainframe system at either 300 or 1200 baud, in either AS-CII or EBCDIC/correspondence codes. Data compression techniques incorporated in the program effectively increase transfer rates between mainframe and the

The program's data management facility includes two-dimensional tables for time-series variables, referenced in common English. A full screen editor allows scrolling, global editing, and subsetting. PCDI automatically keeps track of the user's data files, and an export feature allows data files to be reformatted for entry into VisiCalc and other application programs.

user's system.

The graphical analysis #1

section of the program allows the user to create charts with text, and up to two charts may be displayed simultaneously. Pie charts and histograms can be scrolled to allow the viewing of up to 208 periods of data per variable, and alternate Y-axes are supported. allowing analysis between differently scaled variables. Data can be projected forward an additional twenty periods, using the least squares method.

Text and/or graphics can be printed at any time using an IBM or Epson printer. (List Price: Unlimited corporate license fee \$30,000: monthly rental \$800; Single user package \$250) Requires: 256K, 5Mb hard disk, PC-DOS 1.1 or 2.0, color monitor, color/graphics adapter. Haves Smartmod-Applied Microsystems, Inc. P.O. Rox 632 Roswell, GA 30077 (404)475-0832 (404)371-0632 CIRCLE 734 ON READER

SERVICE CARD

Master Utilities Vol.

Three utility programs allowing features upgrading of a user's system fitted with additional RAM boards. MASTERspooler I allows the user to assign any portion of the available memory to function as a printer spooler driving the serial port. The program will dump the date to be printed into the spooler RAM, freeing the rest of the user's system. MASTERspooler II is similar, but drives the parallel port. MASTERdisc is a disc

emulation program which can create a second or third disc using RAM. All three utilities may be used simultaneousiv, and each of the sections may be allocated as much RAM as required by the user, in 1K increments. The programs will show amount of available RAM still unused in the system (List Price: \$49.95) Requires: 64K, one disk drive, PC-DOS, additional RAM board. Microtek Inc. 4750 Viewridge Ave. San Diego, CA 92123

(619)569-0900 TWX: 910-335-1269 CIRCLE 754 ON READER SERVICE CARD

New On The Market

Maintenance Management System

An integrated maintenance management package that allows the user to maintain records and generate reports on plant equipment, inventory control, and work order processing. The package components consist of Mochine History and Preventive Mointenance, with which the user can maintain detailed records on preventive maintenance schedules and work performed for each machine, as well as complete machine histories and repair work histories: Work Order System, which can keep track of labor, material and total costs for each work order received: and Inventory Control. which stores and retrieves part numbers and other items in inventory, and which keeps track of quantities on hand, based on transactions, (List Price: \$795; manual olone \$25) Requires: 64K, two disk drives, monitor, printer. Unik Associotes 12545 W. Burleigh Brookfield, WI 53005 (414)782-5030

CIRCLE 747 ON READER SERVICE CARD

((MEMORY/SHIFT)) A program designed for the PC-XT, allowing the user to have up to 9 different application programs in system memory simultaneously. ((MEMORY/SHIFT)) also allows the simultaneous use of two monitors, each displeving a different program. and will allow data transfers between different application programs to take place with few keystrokes. (List Price: \$991 Requires: IBM PC-XT: 128K. one disk drive, PC-DOS 1.1 or 2.0. North American Business Systems, Inc. 642 Office Pkwv. St. Louis, MO 83141 (800)325-1485 (314)432-6106 CIRCLE 706 ON READER SERVICE CARD

Textra

featuring block copy and move, global search and replace, wordwrap, and merge from file, and which allows text from one file to be copied into the file being edited. Characters can be inserted by simply positioning cursor and typing, without the need to enter a special insert mode. Six delete functions are available, as are 21 cursor movements controllable from the keyboard.

A word processing program

Other features include paragraph reformatting, line shifting and centering, and definable margins. Printing functions include eutomatic pagination, headers and footers, and single sheet operations. (List Price: \$70; demo disk only \$10) Requires: 64K, one disk drive, PC-DOS, monitor. Ann Arbor Softwore Assocs. 407 N. Moin Ann Arbor, MI 48104

(313)769-9088 CIRCLE 716 ON READER SERVICE CARD

Church Donations A program to automate recordkeeping for churches with up to 2,000 members It allows for entry of names, addresses, pledge envelope numbers, telephone numbers, a 3-character select code, comments, 0-to-4 pledge amounts, and 1-to-15 user-defined categories of data for each member of a

church's congregation. Church Donotions can produce quarterly reports, a complete or selective list of the congregation, mailing labels for ell or selected members, grand totals of contributions to date, and totals to date by individual or offering category. (List Price: \$275) Requires: 64K, two disk

drives, PC-DOS, monitor. Custom Dato P.O. Box 1066 Alamogordo, NM 88310 (505)434-1098 CIRCLE 749 ON READER SERVICE CARD

BLUE Word Processor A color, multi-window word processing program that allows e user to edit up to eight files in up to eight windows simultaneously. Each window's color is user-definable The program provides

formatting features for structured documents, and includes standard word processor features plus footnotes, keystroke macros, format macros, and hyphenstion RLUF Word Processor can support printer capabilities such as proportional specing, micro-justification. underlining, italics, boldface, as well as sub- and superscript. The program allows user modifications as needed, and uses standard DOS files. (List Price: \$150; manual alone \$35) Requires: 64K, one disk drive, PC-DOS 1.1 or 2.0. color/graphics or monochrome adapter, monitor. Symmetric Software Inc. 1805 Clemson St. San Bernardino, CA 92407 (714)887-6595

CIRCLE 741 ON READER SERVICE CARD

PC MAGAZINE 606 SEPTEMBER 1983



The Agency Manager, Applied Systems

Micro-Mail

An electronic mail system (E.M.S.) using microcomputers which do not need to be dedicated solely to the E.M.S. function. The system is menu-driven, and users can choose to either set their systems to send/receive messages and data as needed or overnight in automatic mode. The system can automatically dial each site at predetermined times, exchange messages, or hold messages until the receiver is ready to receive. (List Price: \$500 per site for first four stations; \$400 for station five; \$300 for station six: \$200 for stations seven and up)

Requires: Each Station: 256K Quadboard, two disk drives, PC-DOS 1.1 or CP/ M-86, async port, modem. Worner Computer Systems,

word processing software. Inc. 52 Woodbine St. Bergenfield, NJ 07621 (201)385-6900

(212)395-3395 CIRCLE 743 ON READER SERVICE CARD

MICROCRYPT A file encryption utility providing the user with a means to protect software files and transfers of data over phone lines. Encryption keywords are created by the user for each file. Only by using these keywords can the file be unlocked, MICROCRYPT also features Encrypted file viewing, which allows the user to examine the contents of an encrypted file without permanently decrypting the file. (List Price: \$95) Requires: 64K, one disk drive, PC-DOS or CP/M-86. Sextant Systems P.O. Box 251 Holmdel, NI 07733 (201)671-7670 CIRCLE 766 ON READER

THE AGENCY MANAGER

An integrated insurance agency management packag for the PC-XT, featuring programs to handle customer accounting, general ledges client data updates and file retrievals, over 100 different marketing reports and sales presentations aids, word processing, telecommunications capabilities, utilities, and ACORD forms.

The Agency Manager allows the user to automate the operations of an insurance agency, with the optional capability of linking via telecommunications to insurance data networks. such as the Insurance Value Added Network System (IVANS). The Agency Monager includes WordStar and MoilMerge programs. (List Price: \$3,750, including WordStar and MailMerge) Requires: PC/XT; 128K, PC-DOS 2.0, monitor, printer, Applied Systems Pouling Rd Monee, IL 60449 (312)534-5575 CIRCLE 750 ON READER SERVICE CARD

SERVICE CARD

New On The Market

Business Accounting Control System

An accounting software package consisting of five programs which can be used separately or in unison. The programs-Order Entry/Inventory Control, Accounts Receivable, Accounts Payable, Povroll, and General Ledger-feature screen access to management reports, a screen capacity of up to 132 characters (with appropriate hardware), error checking, and controlled audit trails.

Written in RM COBOL. the Rusiness Accounting Control System can operate under an extensive range of operating systems, including CP/M-86, PC-DOS, TURBO-DOS, UNIX, and XENIX. (List Price: \$1,000-\$1.500 each module)

Requires: 64K, one hard disk. 132-column monitor. printer. American Business Systems,

Inc. 3 Littleton Rd. Westford, MA 01886 (617)692-2600 CIRCLE 719 ON READER

SERVICE CARD

QUESTEXT III

A general purpose textual information control program, incorporating word processing and database management capabilities. The program imposes treelike menu structures on entered text without need for programming or debugging.

QUESTEXT III allows up to 32,700 records, and up to 6,000 screens are possible. Menus can be up to 99 lines each. Categories and subcategories created by the user can be phrased in English, without abstract coding or keywords, and are shown on-screen in English-data structures imposed by the program are invisible to the

A mini version is available, allowing 6 lines per menu, up to 40 screens, and up to 500 records. (List Price: Full version \$299.95: min! version \$49.95; manuol only \$29.95) Requires: 96K, two disk drives, PC-DOS, 80-column

monitor. Information Reduction Research 1538 Moin St.

Concord, MA 01742 (617)369-5719 CIRCLE 714 ON READER SERVICE CARD

DEMI-PLAN Project Management System

A project scheduling/management program allowing the user to define and maintain a file of project tasks and resources. This information is used to print various forms of Gentt charts, resource histograms, and task/ resource cross-reference printouts. The program de termines the critical path of a project and allows the project manager to introduce what if" date to show the effect of data and resource changes on a project's completion date. (List Price: \$74) Requires: 128K, one disk drive, PC-DOS, monitor. printer.

DEMI-Software 6 Lee Rd. Medfield, MA 02052 (617)359-4502 CIRCLE 254 ON READER SERVICE CARD

PCNC

A manual programming assist peckage for Numerical Control (NC) machine tools. PCNC includes a full-function text editor for generating NC programs, and an adaptive backplotting system that can simulate a variety of machine tools. Machine-specific cycle times analysis can predict cutting times. An automatic disk file management system with RS-232 I/O permits

DNC operation. (List Price: \$1,495] Requires: 126K, one 320K

disk drive, graphics monitor, color/graphics card, RS-232 tape punch/reader. Suburban Mochinery Inc. Software Div. 37127 Ben Hur Ave. Willoughby, OH 44094 (216)951-8974 CIRCLE 751 ON READER

SERVICE CARD

Questext III. Information Reduction Research



Health Risk Analysis A program allowing the user to evaluate future life expectancy based upon entered vital statistics, personal habits, past medical history, family medical history. health practices, occupation, and other factors. Using recent Health Risk Tebles. Height-Weight guidelines, mejor medical association health recommendations. occupational safety information, and American Cancer Society suggestions, the program analyzes an individual's risk factors, calculates probable life expectancy, then makes concrete sugges tions for improving longevity through modification of personal health practices. (List Price: Personal Version \$59.50; Professional Version \$259.501 Requires: 64K, one disk

drive, PC-DOS, monitor.
The Center For Medical Microcomputing
P.O. Box 9615
Modison, WI 53715
CIRCLE 731 ON READER
SERVICE CARD

AMI Accounting Package

A menu-driven accounting package consisting of General Ledger, Accounts Receivoble, Accounts Receivoble, Accounts Psyoble, and Poyroll. The maximum number of ledger and sub-ledger accounts, cost contest, transactions posting cycles, vendors, employees, etc., that can be handled by the programs is limited only buser's disk capacity.

General Ledger offers a chart of accounts with sub-

Genéral Leager ofters a chart of accounts with subledger capability and cost counter reporting. Past period adjusting entries can be processed for any period in the current year. Accounts Retorney of the current
Accounts Poyable can operate on a cash or accruel basis. Each invoice can be distributed to cost centers, due dates can be calculated automatically, and partiel payments can be made through the program. The program also allows for flexible payment selection by due date, vendor, and/or specific invoices.

The Poyroll program processes hourly, weekly, biweekly, semi-monthly, monthly, bonus, and com-



MicroRIM. Microrim. Inc.

mission pay types. It can compute regular, overtime, vecation, and sick leeve weges, along with other wage options, and allows up to 10 deductions per employee. It can also calculet an employer's FICA, FUTA, and SUTA requirements. [List Price: Complete Accounting packee; \$1,795; components purchosed seportely; GLI, 5575; AIR, AIP, and Poyroll \$450 eoch] Requires: 645, two disk

Automation Management 5718 Westheimer, #410 Houston, TX 77057 (713)761-5941 (713)761-5942 CIRCLE 727 ON READER SERVICE CARD

drives, MS-DOS.

MicroRIM

A relational database management program. MicroRIM provides data formats, querying capabilities, unlimited number of records or rows, 20 relations (logical files) per detabase, as well as screen editing and report writing ebilities. An optional Program In-

terfoce enables users developing opplications software to reduce development time for software and to link together e group of applications to share a common database. (List Price: \$595; Program Interfoce \$305) Requires: 256K, two disk drives, PC-DOS. Microrim Inc. 1750 12th Ave. N.E. Bellevue, WA 98004 (209) 433-8017

SERVICE CARD

New On The Market

ENCHANTER

The first in a trilogy of relaed fantasy game programs. The player is pitted against Krill, an evil warlock whose ever-incressing powers have already vreaked above upon program. The game's emphasis is on magic. Ultimately, skilled players will have mastered magic so offectively that they will be able to banish Krill forever. ENGHANTER is written.

INTERLOGIC. a proprietary programming system in INTERLOGIC. a proprietary programming system on mornic fanglish. INTER-LOGIC offers a vocabulary of 560 words, covering virtually every aspect of play. (List Price: \$48, one disk drive, monitor, inc. 55 Wheeler St Graphy 101 ST Wheeler St Whe

CIRCLE 736 ON READER

SERVICE CARD



Anti-Glare Screen, Capitol Soles

Pick That Tune A game program containing

100 popular tunes divided into Pop. Country & Western, Children and TV categories. There are 16 game varietions, and from one to ten pleyers can play.

Players bid the number of notes they will need to identify a tune. Using a sound generator, the game program will begin with the lowest bidder and play the number of notes each player has bid until the tune has been picked or all players have missed. Additional tune categories

ries with 100 tunes are

available separetaly, (List
Prices 29.85; odditional
100 tunes \$9.95; odditional
100 tunes \$9.95)
Requires: 64K, one disk
drive, PC-DOS, Advanced
BASIC.
Sweoringen Softwore
6312 W. Little York, #197
Houston, TX 77088
(71.3)937-6410
CIRCLE 731 ON READER
SERVICE CARD

....

Anti-Glare Screen
A screen composed of a

A screen composed of a finely woven mesh of synthetic material that eliminates glare from displey screens. The appearance of the display is altered so that characters appear on a dark background as opposed to a light one. Ambient light, not originating from the monitor, is kept from reflecting into the system user's eyes. The creen fits into the

ACCESSORIES

recessed opening of the IBM CRT, and can be used for either monochrome or color monitors. (List Price: \$39.95) Copitol Soles Co. Ja740-J2 Research Blvd. Austin. TX 78750 (800) 531-5255, ext. 804 (800) 252-9146, in Tex. (512) 250-8757

CIRCLE 762 ON READER SERVICE CARD

Financial Reporting System II (FRS-II)

System II (FRS-II)
A reduced-size version of
the PDS Financial Reporting
System, providing the user
with a basic accounting system capable of producing
general ledgers and financial
statements. Users can at any
time upgrade to the full Finonciol Reporting System
without affecting stored
data.

The full system allows for budget and last year comparisons, user-defined statement formats, as well as a link to Multiplon spread-sheets. (List Price: Bosic system; \$600 U.S.; \$750 Canodi-

on)
Requires: 64K, two 320K
drives, monitor, PC-DOS 1.1
or 2.0, 132-column printer.
Protrie Doto Systems, Inc.
626 Broadway Ave. #202
Soskotoon, Soskotchewon,
S7N 1.49 Condo
(306)384-7110
CIRCLE 78 ON READER
SSRVICE CASE

Video Screen and Plastic Cleaner A cleaning solution formu-

lated for electronics equipment, with anti-static and dust resistant properties. It will not harm glass or plastic. (List Price: \$5.00 pint-\$30 gollon) Nu Look Products, Inc. P.O. Box 4678 Hollywood, FL 33023 (305) 981-9330 CIRCLE 744 ON READER

UCC-4 Universal Charge Card Form A universal charge card form that can be prepared automatically by a user's system and printed on any printer accepting a 91/2-Inch form. The forms are preprinted with the scannable font consecutive numbers required by major credit

card companies such es

American Express. The UCC-4 Form is e stock, off-the-shelf item. and is peckaged 2,500 forms per carton. Special programming guides are available indicating print positions for either sixline/inch or eight-line/inch printouts. (List Price: 1-3 cartons \$95 each: 4 or more cartons \$85 each) CBI Corporation 1164 N. Tower Ln. Bensenville, IL 60106 (312) 860-2880

Xidex Precision Flexible Disks A line of 51/4-inch and 8-

inch floppy disks, featuring a proprietary magnetic particle-coating formulation to achieve megnetic signal strength epproximately 20 percent greater than industry average. The disks are packaged in an extra thick disk tacket for protection and durability. (List Price: 51/e-inch disks \$4.50-\$7.50: 8-inch disks \$5.40-\$7.20) Xidex Corp. 305 Soquel Woy Sunnyvole, CA 94086 [408] 739-4170

CIRCLE 763 ON READER

SERVICE CARD

Modular Computer Furniture

A new line of computer furniture that expands vertically as the user adds more hardware, peripherals and software. The modules have rounded edges and are furnished in Ashley Oak vinyl veneer with black matte vinyl accent panels.

The full line consists of a Desk (CT-130), Roll-About Teble (CT-120), Hutch (CTA-131), and Monitor Platform (CTA-132). The desk will hold a monitor. keyboard, disk drive end printer. There is also a lockable security cabinet beneath the top. The 44 inch wide work surface has a rear-mounted safety retainer edge. Wire harness clips are attached to the beck to organize equipment cords.

A coordinating butch has an 111/2-inch deep top book shelf with an eccess opening for cords. The interior shelves are adjustable and/ or removable.

The Video Monitor Pletform (CTA-132) can be used on either the Roll-About Table or Desk to make a self-contained computer center. (List Price: Desk \$169.95: Hutch \$99.95; Roll-About Toble \$79.95: Video Monitor Plotform \$17.95) Rush Industries, Inc. 312 Fair Oak St. Little Volley, NY 14755 CIRCLE 767 ON READER SERVICE CARD



Modular Computer Furniture. Rush

LABEL WARE

A set of disk identifying labels in three types. Each package consists of the following: 56 1-inch × 1/2-inch rect-

angular tags including Master, Beck Up. Copy. General Ledger, Payroll, Accounts Payable, Accounts Receivable, Spreadsheet, Detabase, Vol #___ Version___, Games, etc.

60 1/4-inch circular universal symbols for Keep Dry, This Wey, No Smoking, No Magnets, No Touching.

8 41/4-inch × 11/4-inch blank disk labels with universal warning symbols suitable for both 51/4-inch and 8-inch disks. (List Price: \$3.00) The DP Consultant P.O. Box 1174 Plano, TX 75074 (214) 596-0594

CIRCLE 265 ON READER

SERVICE CARD

CIRCLE 766 ON READER Precision Flexible Disks, Xidex Corp.

SERVICE CARD



New On The Market

PUBLICATIONS

Public Domain Software

A library of public domain software, featuring 38 disks of programs for the IBM PC. The disks contain over 400 programs including a ramdisk, spooler, numerous games, utilities, spreadsheet templates and demos, as well as programs for modem communications, disk file maintenance, graphics, financial calculation, database retrieval, and education. (List Price: Directory of ovailable programs \$3.00; complete set of 38 disks \$80; a set of ten most populor disks \$50)

PC Software Interest Group 1556 Halford Ave. #130P Santo Clara, CA 95051 (408) 247-6303

CIRCLE 761 ON READER



MicroSoftwore Solutions by Career Aids

MicroSoftware Solutions

A catalog of microcomputer programs, books, eccessories, and games, Featuring detailed descriptions of over 100 products in 22 formats, the catalog offers programs and books in Word Processlng, Accounting, Time/Job Scheduling, Databases, File Management, Graphics, Real Estete, Tax Preparation. Electronic Spreadsheets. Medical/Legal Software, and Mailing List programs. (List Price: Free) Career Aids/MicroSoftware Solutions 8950 Lurline Ave

8950 Lurline Ave. Chotsworth, CA 91311 (213) 341-8279

CIRCLE 787 ON READER SERVICE CARD

Applications Software Catalog

A catalog listing accounting and billing applications software, including receivables packages, general ledger programs, integrated accounting packages, and project manegement systems.

The catalog, designated

Catalog B-53, lists programs by such professions and industries as job costing manufacturing, home building, and engineering consulting. (List Price: Free) Monument Computer Service Villoge Data Center P.O. Box 803

P.O. Box 803 Joshuo Tree, CA 92252 (619) 365-6668 CIRCLE 759 ON READER U.P.S. Catalog

O.F.S. Catalog
A 20-page brochure describing the power problems that
can adversely affect computer installetions, and how
Uninterruptible Power Systems (U.P.S.) can eliminate
them.

tens (U.F.) Can eliminate them. Drochure also includes detail specifications for Gould's line of 300 VAC of 45 VAC single and three-phase systems. Battery assection and application data is also provided. Clair Gould Inc., Power Conversion Div. 2277 Kurt S. Son Diego. CA 82110 (19) 287-2111 CERCLE 360 CM READER

SERVICE COMP

Learning to Use the PC

A learning guide designed as a hands-on tutorial for the first-time user. It shows the user how to solve business problems, using examples that indicate what to expect when beginning to use the PC, what the user is doing right, what can go wrong, and how to correct inevitable mistakes. (List Price: \$14.951 O.E.D. Information Sciences, Inc. P.O. Box 181 180 Linden St. Wellesley, MA 02181 (617) 237-5656 CIRCLE 756 ON READER SERVICE CARD



If you think \$1495 for a 10 Mbyte high quality hard disk is a good deal, then wait until your computer dealer tells you about our \$695 25 Mbyte tape back-up.

The Pegasus 10 comes complete with all the software and hardware you need to start operations.

If you've outgrown the storage capabilities of your IBM PC or compatible computer but haven't grown into the giant pricetags on 10 Mbyte hard disk systems, you're in for a surprise. The price on a complete 10 Mbyte system featuring the

latest Shugart components just reached an all time low!
For the first time, just \$1485 gets you everything you need to start working on your hard disk system:

Top quality SA612 10 Mbyte (formatted) fixed hard disk

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- SASI controller card
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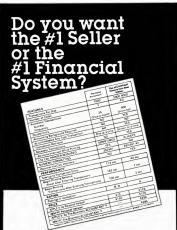


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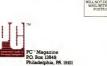
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Software Engineering And The PC

I'm living dangerously.

The presence of the term "software engineering" in my title might lead you to think that I know what it means. Well, I do have my own definition, but for the most part this term is used more widely than it is understood, even by computer scien-

This is a big problem. My theory is breet go out on another limb, watch out below) that, unlike the principles of lowed in the disciplines of civil, mechanical, and electrical engineering, the mathical engineering, the mathical control of the con

all the way up (or is it down?) to the practitioner's level.

A key word here is "discipline." Really good software developers, whether they exhibit any creativity or not. have a strong discipline of design and programming that they understand and its which they understand and its which they alter fight. As a reall, that they are all the strong strong the strong strong the strong ware has provisions that can accommove the strong strong the strong ware has provisions that can accommove the strong strong the strong ware has provisions that can accommod the strong strong ware has provisions that can accommod the strong strong ware has provisions that can accommod the strong that the strong ware to be carefully written, with understand the strong ware to be carefully written, with the strong ware to be carefully written, with the strong ware to be carefully written, with the strong ware to be carefully written, with the strong ware to be carefully written, with the strong ware to be carefully written, with the strong ware to be carefully written, with the strong ware to strong ware to be carefully written, with the strong ware t

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gram development environment that thay can get. The reason for this desire is their clear knowledge that a better working anvironment can save vest amounts of time in the software davalopment process. Furthermore, a good anvironment is vital whan more than one person is working on a project. The question is, how well does the IBM PG or XT serve as a programmer's

THE OPERATING system defines the limitations of the total environment in a number of complicated ways.

workbench? The answer comes in two parts; dealing with IBM's hardware and software.

The Hardware

The physical aspects of a good devalopment system are easy to state. They have to do with capacity and perfor-

First, the system needs to have adequate main memory. The IBM PC is up to this task; the 640K capacity of the system is more than enough for e single user. Assuming that the CPU is up to it, a multiterminal system with 640K should support about four users. Installing 128K is an absolute necessity; this capacity is enough for most uses.

Next, the CPU itself needs to perform well. While much depends on the software in use, it is asle to say that e single use will have no problam with the IBM's parformance. For multi-terminal use, the CP might be a little on the slow side due to the 8-bit data bus. Given the usual mix of program development work (lot of siditing, with bursts of compiling sed in kinking, and the complete of the compiling and in kinking and the compiling and in kinking and the compiling of the compiling and in kinking and the compiling and the compiling and the compiling and the compiling and in kinking and in kinking and the compiling and the compil

Third, disk capacity must be large. The 320K (or 360K) capacity of tha IBM disk drivas is small. Yes, it is possible to do productive work on a single, 160K disketta system, but it is very inconvenient. Low mass storage capacity is a critical factor working against efficiency, so a disciplined professionel programmer will always seak "adequata" capacity for the work in progress. A simple example: It is highly dasirable to have the operating system, some utilities, the program editor, the language compiler, the linker, and all other commonly used tools instantly availabla. Fitting most full-function compilers on even a 360K capacity disk will be a squeeze. The 360K also shrinks quickly when a project's source, object, and executable files are all kept on one diskette. the preferred arrangement.

the preterred arrangement.

A single organized progremmer working on a medium-sized project should find
the standard PC with 258K of main memory and two 320K diskette drives to be
manageabla. The addition of a 10-megabyte hard disk is highly dasirable and usually eliminates capacity problems, although it may make backup procedures
more complicated.

Fourth, mass storage performance has dramatic effect on total system throughput. Even if a disatetis—based navironment provides adequate capacity, the speed of data transfer can slow the overall operation. Hard disks usually offer better performance, although some have characteristics like the floopy drives. Electronic disks (portions of memory set saide to be streated as a disk) or each schemes can belp improve the performance of any configuration.

Finally, the choice of a printer is important. Here the developer must consider the amount of printing to be done and choose e printer that offers en eppropriate throughput.

From these considerations, we can conclude that the XT is a good hardware anvironment for development, while the standard PC is adequate under certain circumstances. The use of an XT is somewhat hampered by the lack of edequate backup capability.

The Software

The operating system, with its associated utilities and programs, is the most important factor to consider when building e development environment. The operating system defines the limitations of the total anvironment in a number of complicated ways.

First, the operating system must pro-

vida a powerful yet easy-to-use human interfece, in this case, asso of use is determined by how the system meets the developer's needs. An approprise intercentage of the confusing or obscure to a non-technical users insore the professional may be willing to sacrifice some amenitas in arove of greater fensibility. Nonatheless, the interfece should work in a consistant askino to reduce the amount of information that must be learned and remambered by the user.

Second, the systam should provide the tools needed by the programmer to organize his or her work. Tools should also be available to help the programmer deel with the mass (or maze) of collected

An example might halp to clarify what I mean here. Consider a system with PC-DOS 2.0, a hard disk, and a hierarchical directory structure (directories that can contain other files and directories, organized with an arbitrary number of levels of nesting). The programmer carefully organizas tha data, but one dey wishes to retrieve a particular file (let's call it FRED), one of about 400 files contained in 30 directories, PC-DOS 2.0 provides no direct way to find out where that file is! Yes, it is possible to give a TREE /F command, which can list all files in all directories, but then this list must be examined manually. Even the FIND command. which could search TREE's output to find "FRED," cannot associate it with its parent directory. Sounds triviel, doesn't it? But, for e professional it's more then a headache and it's wasteful of time.

to death of a system that requires you to use a special utility to clean up the disk space.

Third, the utilities and tools provided by the system must be well integrated with themselves. PC-DOS 2.0 has the capability to "spool" text files to be printed. This ellows the user to do something else while the printer is running, a feature referred to as bockground printing. But tha spooler is very limited. It cen only handle 10 files, a very small number to e software developer. Control of the spooler is limited to the command leval, so programs can-

HE HARDWARE of the PC is suitable as a development work station.

not direct that printed output so through the spooler to the printer; instead, output must be directed to a file and be manually (or through a batch file) spooled with the PRINT command. In other words, this spooler is not an integral part of the systam, but rather e simple utility of limited

cepebility. Finally, the softwere must be relieble. Do you know what the utility CHKDSK does? Most of us think of it as e utility to displey how the disk is being used and how much space is left. A rerely stated purpose of CHKDSK is to recover spece on the disk from files that had been changed or daleted. This space is "freed" and made available once again, Personally, I'm scared to deeth of e system that requires you to use a special utility to clean up the disk space. It makes me fear that some of my valuable dete files might not be taken care of properly.

The Bottom Line

I've said that the hardware of the PC is suitable as a development work station. You might infar from my comments above that also I think PC-DOS is somewhat lecking as a development environment. Thet's a fact. Worse, I think PC-DOS 2.0, for all its good feetures, does not much improve the situation.

Is there a better choice of operating system? Unfortunately not. Although a developer mey choose to work in a better dayalopment environment, the fact of the metter is that the ultimete execution environment for PC softwere will be PC-DOS. because that is the one running on most machines. Any other system would support only its own execution environment, not PC-DOS.

I guess we'll just have to wait for PC-DOS 3.0 or 4.0 or . . . /PC

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Coming Up In *PC Tech* **Iournal**

Program Editors

These software tools, similar to word processors, help programmers transcribe their thoughts into an electronic medium. Our comparative evaluation will examine many of the program editors now available.

Freeware

An experimental method of distributing software: Authors make software available free of charge and ask for voluntary contributions from satisfied users. We take a look at how well this method works and review three programs available as Freeware: PC-Talk III, PC-FILE, and CHASM (the Cheap Assembler).

DOS 2.0

Microsoft claims the PC's operating system is now a bridge to Xenix, but it still has more rivers to cross.

IBM FORTRAN

What are some of the problems with the PC's version of this scientific programming language?

Converting Word Processor Files

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Coming Up



Printer Roundup

A monster roundup of super dot-matrix printers. The Toshiba P1350, the Okidata 2410, the Prism-132, the Printek 920, the Anadex WP-6000, the OMNI 800, the DS-220, and more are reviewed in the October issue of PC.

Goblins and Gremlins: PC Repairs

What's it like to walk into an office full of people crying and screaming about broken PCs? Hear it from the repairman's side.

And, when the lights don't glow, where do you go to get your PC fixed? Is IBM the only place?

Confessions of a Programming Virgin Writer Eric Freedman chronicles his first attempt at writing a program with

Writer Eric Freedman chronicles his first attempt at writing a program with minimal help from courses, books, friends, lovers, and strangers on the street.

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Lindsy Van Gelder assesses some of the hopes and claims of the grammar checkers.

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Canadian writer Marianne Paul tells the story of her 2-year-old word processor—

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